WATER CONSUMPTION AND ECONOMIC GROWTH IN JORDAN: AN INPUT-OUTPUT ANALYSIS

By

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FINAL READING APPROVAL

To the Graduate Council of the University of Utah:

I have read the dissertation of Bassam Mohammed Abual-Foul in its final form and have found that (1) its format, citations and bibliographic style are consistent and acceptable; (2) its illustrative materials including figures, tables, and charts are in place; and (3) the final manuscript is satisfactory to the supervisory committee and is ready for submission to The Graduate School

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ABSTRACT

The problem of water shortage in Jordan has increased over time and has recently become an acute problem, particularly during the drought. Various factors contribute to water shortages in Jordan such as the arid climate of Jordan, the increasing demographic pressure, the expansion of the economy, and the water rights conflict over the Jordan River. Moreover, changes in the sectoral composition of water demand in the economy call for a countrywide water plan involving the rethinking of policy regarding the present plan of allocation of water resources among different uses.

The objective of this research is to show how the problem of water shortages in Jordan could affect the process of its economic growth and development. To do so, we estimate two growth scenarios for the economy of Jordan over the period 1990 to 2000 and take these as alternative objective functions (or welfare functions) for economic and social development in Jordan. Our primary concern is to determine the feasibility of achieving these goals. The model utilized in this study is an input-output matrix of Jordan for the year 1983. Using that, we determine the effects on the level of demand for water of an expansion in the Jordanian economy as it pursues its plan for growth and development.

The primary focus of this research is on the demand for water created by the requirements of water for different sectors as the result of meeting the growth goals explained by the plan. The study has shown that with the limited supply, there will be a deficit under both growth scenarios in the water supply in Jordan from the year 1995 onward.

Finally, the study has focused on various plans that may alleviate the problem by encouraging water conservation at three broad levels: the domestic, the industrial, and the agricultural. It is necessary to emphasize other measures for increasing water supply through sources such as; recycling effluent, desalination, improving storage and delivery systems, studying the feasibility of cloud seeding, and importing water from water-rich neighboring countries. Moreover, the issue of water rights between Jordan and its neighboring countries must be expeditiously resolved.

To my mother, brothers and sisters, and to the memory of my father, I dedicated this dissertation.

(إلى والدتي و إخوتي و أخواتي، وإلى والدي بمناسبة ذكرى وفاتة)

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CHAPTER 1

INTRODUCTION

Most people associate the Middle East with oil and the prosperity it has brought. In the long run this is an incorrect emphasis. The crucial problem is the availability of water. Certainly the heart of the Middle East historically and today is the Jordan Valley where the two great continents of Africa and Asia come together and where Europe has been so deeply involved over the millennia. Here the issues surrounding the availability of water can be seen in all its stark complexity.

Water is an essential requisite to all life. About 71 percent of our planet's surface is covered with water of which only 3 percent is usable (Miller Jr. 1990). There are many developing countries where water is a scarce resource[1] which may eventually pose as constraints on economic growth. One such country is Jordan, a country with an area and population

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[1] Munasinghe (1992) argues that according to Falkenmark (1989), water shortages could occur in a situation where the annual renewable water resources fell short of 2000 cubic meters per person while there is an increasing demand for water due to the development process. Munasinghe (1992) also added that in 1990, according to World Bank, all countries of the Middle East and North Africa, and five countries of Eastern Africa and four countries of Southern Africa have become a good example of such situation where the annual renewable water resources per capita is less than 2000 cubic meters.

comparable to Kentucky. Jordan is mostly an arid country receiving on average 200 millimeters (about 7.9 inches) of rainfall annually.[2] This, when compared to the minimal requirement of 400 millimeters (about 15.8 inches) of average annual rainfall for cultivated agriculture (Coone et al. 1981), reveals the magnitude of water scarcity in Jordan.

Jordan is effectively an urban state with approximately 70 percent of the population living in locations with populations over 5000. The continuing economic development of Jordan is crucially linked to its efficient use of water resources. The problem of available sources and distribution of water are further complicated by Jordan's historical relationship with Israel (Wishart 1985 & 1989). This historical relationship continues to dominate the allocation of water in the Jordan Valley, the most important agricultural area in Jordan, as well as the source of most of its water resources.

1.1 Rationale of the Research

The problem of water shortage in Jordan has increased over time and has recently become acute problem, particularly during periods of drought. The increases in population and the expansion of the economy has put more pressure on the

[2] About 200 millimeters (about 7.9 inches) of rainfall annually is received on about 91.4 percent of the country, while a level of annual rainfall between 200 to 500 millimeters is received on 8.6 percent of the country's area (FAO 1982, 54).

available water supply thus calling for a countrywide water plan involving the rethinking of policy regarding the present plan of allocation of water resources among different uses. The extent of the water problem in Jordan increases every day. For example, Salameh (1992), a hydrologist at the University of Jordan, warns that Jordan is using about 120 percent of its annual renewable resources of water. He also added that Jordan is overusing its nonrenewable resources which cannot be replenished by rainfall. Also, in an interview with the French Press Agency and published in the AD-Dustour Newspaper in Jordan, Ku'war (1993), the Minister of Water and Irrigation in Jordan, argued that the water problem in Jordan is increasing: it is expected that the water deficit in the country will reach about 70 percent by year 2005. Thus the water issue will become increasingly critical over time unless some measures will be taken to alleviate it.

Various factors contribute to water shortages in Jordan, such as the arid climate, the increasing demographic pressure, and the water rights conflict over the Jordan River. Moreover, changes in the sectoral composition of water demand in the economy make it crucially necessary to reevaluate the policy with respect to allocation of water resources. It is hoped that the present research will contribute to the process of evaluating water resources in the context of economic development and as an aid to better decision making.

An added motivation for this dissertation is the lack of

research in the area of Jordanian water resources. Therefore, this lack calls for more studies on a large scale in the area as it relates to both short- and long-term planning. Further, I believe this research could be extended and applied to cases in other countries that face similar problems of water shortages as in the case of Jordan.

1.2 Methodology

The objective of this research is to show how the problem of water shortages in Jordan could affect the process of its economic development. To do so, we estimate two growth scenarios for the economy of Jordan over the period 1990 to 2000 and take that as the objective function (or welfare function) for economic and social development in Jordan. Our primary concern is to determine the feasibility of achieving these goals. The model utilized in this study is an input-output matrix of Jordan for the year 1983. Using that, we determine the effects on the level of demand for water of an expansion in the Jordanian economy as it pursues one or the other plan for economic development.

The present research will concern itself indirectly with attempts to devise an efficient pattern of allocation of water resources among its competing users, but the primary focus will be on the demand for water created by the requirements of water for different sectors as the result of meeting the goals defined by the plan. With this completed, comparisons will be

made between the amount of water demanded and the amount of water supplied, emphasizing that the likely outcome will be a shortage of water.

Finally, the study will focus on various proposals that may alleviate the problem by encouraging water conservation in the three broad categories: domestic, industrial, and the agricultural. It will be necessary to emphasize other measures for increasing water supply through sources such as; recycling effluent, improving storage and delivery systems, studying the feasibility of cloud seeding, and importing water from water-neighboring countries. Moreover, the issue of water rights between Jordan and its neighboring countries must be expeditiously resolved.

1.3 Organization of the Study

The purpose of this dissertation is to examine the use of input-output analysis in the area of water resources modeling and its applicability on a countrywide basis. Thus in this study, an input-output model has been used in order to determine the consumption of water in the economy of Jordan under two growth scenarios over the planning period 1990-2000. The model has been also used to estimate the demand for water by each sector of the economy and then to compare the total demand with the available supply of water in Jordan pointing out the acuteness of the problem of water scarcity and what should be done about it.

The study is organized as follows: Chapter 1 introduces the problem and the rational of the study and its objectives. Then it describes the methodology of the study and the data sources utilized in the research. It concludes with the review of the literature on using input-output analysis in the area of water resources modeling.

Chapter 2 presents a description of Jordan by focusing on its physical characteristics and its climatological conditions. It shows that the country is divided into three major regions: the Jordan Valley, the Highlands, and the Desert plateau. Also, this chapter presents a description of the temperature levels in different regions of the country. It also shows the distribution of precipitation levels over the country.

Chapter 3 presents a brief description of both the historical and the economical background of Jordan. It shows the history of Jordan from early ages until now. It also describes the economic conditions of the country in terms of its economic growth and performance, population, labor force and employment, agricultural sector, industrial sector, and services.

In Chapter 4, Jordan's Water resources are described. Chapter 4 shows the water supply system in terms of its availability and sources. It also briefly describes other possibilities of seeking other sources to increase water supply in Jordan.

The theoretical framework of the model utilized in this study is developed in Chapter 5. It discusses the input-output model as a theoretical framework for the analysis of planning of water resources and its allocation among different sectors in the economy. It also derives different types of input-output multipliers.

Chapter 6 begins with an analysis of the data and the interpretation of the findings. In the first part, it presents a general description of the input-output tables of Jordanian economy for the base year 1983. Then it shows the empirical results for this study.

Chapter 7 continues with the empirical results and economic projections. It presents an overview of water requirements in the economy of Jordan for the base year 1983. It also develops the projection of both final demand and water requirements for the planning period 1990-2000.

Finally, Chapter 8 presents policy considerations and recommendations which conclude this dissertation.

1.4 Data Sources

The data used in this research have been obtained from governmental sources, international institutions like the United Nation, and other published and unpublished research. A full listing of data sources may be found in the bibliography.

1.5 Literature Review

Since its development in 1936 by Nobel Laureate Wassily Leontief, input-output[3] analysis has been applied by decision makers to assist them in their policy decisions and planning. Its importance in economic analysis has been summarized by Robert Dorfman who said:

> There can hardly be an economist who has not watched with amazement that area of economics, input-output. (Dorfman 1954, 121)

Input-output analysis is useful in exploring the interdependence among different sectors or industries in an economy as a whole. Leontief says about input-output analysis that:

> Input-output analysis is a method of systematically quantifying the mutual interrelationships among the various sectors of a complex economic system. In practical terms, the economic system to which it is applied may be as large as a nation or even the entire world economy, or as small as the economy of a metropolitan area or even a single enterprise. (Leontief 1986, 19)

In general, the literature is rich with research using input-output analysis in regional and interregional development and planning for both developed and developing countries. Input-output has also been used to analyze the effects of particular resources or inputs in the production process for economic development. Of specific interest are

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[3] As the literature shows, input-output started with the work of Francoise Quesnay in the 18th century when he published his famous work Tableau Economique (Phillips, 1955, 137-144).

those studies that examine the constraints on economic growth that arise from the scarcity of particular resources such as water. In the present review of the literature some of these studies which utilize input-output analysis will be discussed.

On the importance of the use of input-output analysis in the field of urban studies, Werner Z. Hirsch stated that:

> Input-output techniques are today's most potent tools for systematic study of direct, indirect and income-induced economic changes on the urban scene. . . . input-output techniques can make valuable contributions to the solution of a variety of major urban problems. . . . . . . Input-output analysis is especially applicable to a study of area-wide problems and it occupies a pivotal role in regional interaction analysis. . . . . . . Finally, input-output techniques can be adapted to shed light on land requirements that are likely to result from a variety of forces, such as zoning changed, central government housing legislation, or tax revisions. (Hirsch 1967, 151-152)

In developing countries, input-output techniques have been applied in analyzing the economic interdependence among different sectors of the economy, and the process of economic development. For example, Gamal Eleish (1967), using the input-output tables of the Egyptian economy in 1954, argues that the import substitutions will play a significant role in the level of industrialization in the Egyptian economy which will ultimately affect the technical coefficients stability of the economy. He then estimated the direct and indirect imports needed by each sector of the economy to satisfy a unit

delivery to the final demand. He concluded that with reference to the current structure of the economy, the stability of the technical coefficients of the Egyptian economy are more likely to change than that of the developed economy.

In the case of Bangladesh, Mustafa K. Mujeri and Mohammad Alauddin (1992) used the input-output analysis to study the level of imports in the consumption patterns of Bangladesh. The paper presents an estimate of the imports required to support different consumption levels in different sectors. They argue that many of the imports are used to support the basic consumption level of the society, and also it is directed towards supporting the consumption of a special group, "the urban elite."

In the developed world, the use of input-output models are primarily applied to analyze impacts on local economies that would result from different policy programs. Several studies were done utilizing the input-output analysis. For example, in their study of Utah, Moore and Petersen (1955) use an input-output model to study the interindustry relationships in the economy of the state of Utah, U.S.A. By estimating the employment and income multipliers, the study shows the significance particular sectors are to the economy of Utah.[4]

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[4] Another study in 1967 by Iver E. Bradley used input-output analysis to examine the interindustry interactions among different sectors in the economy of Utah. He used the input-output table for Utah, 1963, in value terms, to calculate the output, and income multipliers. Bradley used actual data as opposed to the approximations used by Moore and Petersen based on the U.S. input-output data (Bradley 1967, 1-13).

Also, a study by Werner Z. Hirsch (1959) used an input-output model to study the effect of exogenous forces such as changes in the final demand upon the economy of a metropolitan area. The study focused on the St. Louis area where he estimated the income and employment multipliers for the area which helps or may be used by the decision makers in their planning process.[5]

Another application of input-output model is in the area examining the role of a particular resource on an economy, for example energy. That is, to determine how much the economy as a whole or certain sectors of the economy will use energy in its production process of different goods and services. For example, Gowdy and Miller (1987) used input-output analysis to show the energy use in the services sector of the U.S. economy. For the purpose of their study, they used the input-output tables of the U.S. for the years 1972 and 1977. They estimated, for the years 1972 and 1977, the total energy (direct and indirect) requirements by the services sector per dollar of output needed to satisfy the final demand. Then they compared the levels of the energy use by the services sector in the years 1972 and 1977 and they concluded that the use of primary energy and secondary energy would have declined by 23 percent and 12 percent, respectively had the energy technology

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[5] For other studies utilizing input-output model on a regional level, see, for example, Miller (1957, 200-209), Tiebout (1969, 334-340), and Baum et al. (1990, 54-71).

level of 1977 being applied in 1972.[6]

Finally, there have been a series of studies that analyze economic development using input-output analysis where water is the constrained resource. Hartman (1965) used input-output model to study the problem of allocation of water resources among different uses and regions, particularly for a small agricultural economy. That is, to examine the income loss resulting from loss of a certain crops output in a location where water is being transferred from one use, such as agriculture, to anther location.

A study by Bradley and Gander (1968) examined the allocation of water resources for the State of Utah using input-output techniques. Using Utah's input-output tables for the year 1963, they estimated the water coefficients (directly and indirectly), the output multipliers, and income multipliers for different sectors of Utah's economy. Then they projected total water use for Utah for the year 1975.

There has been other studies in the area of water resources development that use the input-output methods as a framework for their analysis. For example, a study performed by Davis (1969) has focused on the interactions of different economies of the western states of the U.S. and their interdependence on each other with emphasis on water resources

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[6] See also John L. R. Proops (1977 and 1988) for another application of input-output analysis to energy intensities. See also, as examples, Pal Erdosi (1985), Hannon and Blazeck (1984), Gould (1986), and Cocklin et al. (1989).

issues.[7] Using, with some adjustments, the input-output tables available then for these western states, he developed a water coefficients matrix for each region. Then he presented the interregional dependencies in terms of water supply; he used California as an example, to point the interregional dependencies by finding the coefficients of water dependency of the western states on California waters.

Bargur (1972) used an input-output approach and linear programming methods to analyze the problem of regional water resources and its management.[8] The study utilizes a dynamic multisector programming model to examine the management of scarce resources, particularly water and labor. The study was applied to California and to ten US western states where a planning period of fifteen years was implemented, and it also suggested an optimal resource allocation. Taking into consideration different levels of water scarcity as a constraint, the model used two objective functions, one based on the maximization of gross regional product, and the other based on the maximization of consumption. The study also examined the regional and interregional transfer of water and

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[7] For a related study on the interregional interdependency focusing on water resources, see Ireri and Carter (1970) where they studied the economic links, and the effects of water transfer and their allocations on the economies of both states of California and Arizona.

[8] Previous series of studies by University of California, Berkeley were performed on the economic evaluation of water where parts of these series used input-output analysis to examine the effect of scarce resources, particularly water resources on the California economy. For Further information on these studies, see Lofting and McGauhey (1963), Bargur and McGauhey (1969), and Department of Water Resources, California (1980).

its effect on economic growth of gross regional product. Besides, the shadow prices for water and labor resources were estimated.

The use of input-output model in the area of water resources planning was also applied by James E. Moncur (1974) to study the water supply system for Hawaii.[9] The study estimated the direct and total (direct plus indirect) water requirements by different sectors of the economy as well as the water multipliers. It also estimated the income and employment multipliers for different sectors of the economy.

A study by Gray and McKean (1976) examines the effect of economic activity on water use in a regional economy. They used input-output analysis to estimate the effect of changing in final demand on the level of water use (direct and indirect) in each sector of the economies of three counties of the State of Colorado, U.S.A.[10] That is, they estimated the total water use by sectors necessary to satisfy a projected changes in final demand.

This work has been extremely helpful in formulating the problems raised by this dissertation.[11] They have helped in

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[9] The Hawain study acknowledged the limitations of the data used in the study, where some data were not available for certain water using sectors. Therefore, some estimates were used to explain the model.

[10] Another study by Hendricks and De Haan (1975) adapted input-output model to water resources system for the South Platte Basin (Hendricks and De Haan 1975, 1-92).

[11] It is worth mentioning that the above studies are different from this dissertation in terms of treating water sector in their analysis. They have considered water sector as an exogenous sector in their analysis where this dissertation treated water sector as an endogenous sector in

emphasizing certain issues rather than others in techniques of analysis, qualification of results, manifestation of the data, and above all in providing a course of reality in knowing that the analysis, in spite of its many pitfalls, is in the mainstream of empirical economics.

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the model.

CHAPTER 2

PHYSICAL CHARACTERISTICS OF THE REGION

Jordan is a country with an area of about 92,500 square kilometers, a population of about 3.1 million (as of 1989), and with a varied topography. It has an East Mediterranean, hot and dry during summer season and cold and humid during the winter. The level of rainfall fluctuates over the country, where it reaches its maximum on the eastern hills overlooking the Jordan Valley, and progressively decreases as one moves to the eastern and to the southern part of the country where it is primarily a desert. In terms of temperature, it can reach 15 centigrade below zero especially in the high elevation areas during winters, and about 40 centigrade in the Jordan Valley during the summer season. Another factor that affects the climate are the Khamaseen Winds which blow during summer. These winds are characterized by being hot and dry, and usually accompanied by sand. They are the southeastern winds which blow from the Saudi Arabian Desert.

This chapter is divided into two parts. In the first part I will briefly discuss the physical characteristics of the three major regions in Jordan. These are, from west to east, the Jordan Valley, the Highland, and the Desert plateau (see

Figure 2.1) (Saleh 1991, 18). Then, in the second part, I will briefly examine the climate of the country by focusing on the temperature and the precipitation levels over the country as a whole.

2.1 Topography

2.1.1 The Jordan Valley

The Jordan Valley occupies the west part of the Kingdom of Jordan, and it is a part of the great African Rift valley system which extends from Lebanon southward to the Gulf of Aqaba on the Red Sea (see Figure 2.1). This from Lake Tiberias (sometimes referred to as the Sea of Galilee) at north to the Gulf of Aqaba at south. Its length exceeds 660 km and its elevation is roughly 400 meters below sea level at the Dead Sea (Balbesi and Beni-Hani 1990, 35). The Jordan River flows through this valley southward from Mount Hermon which is the source of its tributaries, and passes through Hulah Marshes to Lake Tiberias. From the lake, the Jordan River meanders southward where it meets the Yarmouk River, another major tributary, south of Lake Tiberias, to the Dead Sea, which is the lowest point on earth, into which it drains. The remaining part of the Valley, south of the Dead Sea, is known as Wadi Arabah.

Water resources in the Jordan Valley depends mainly on

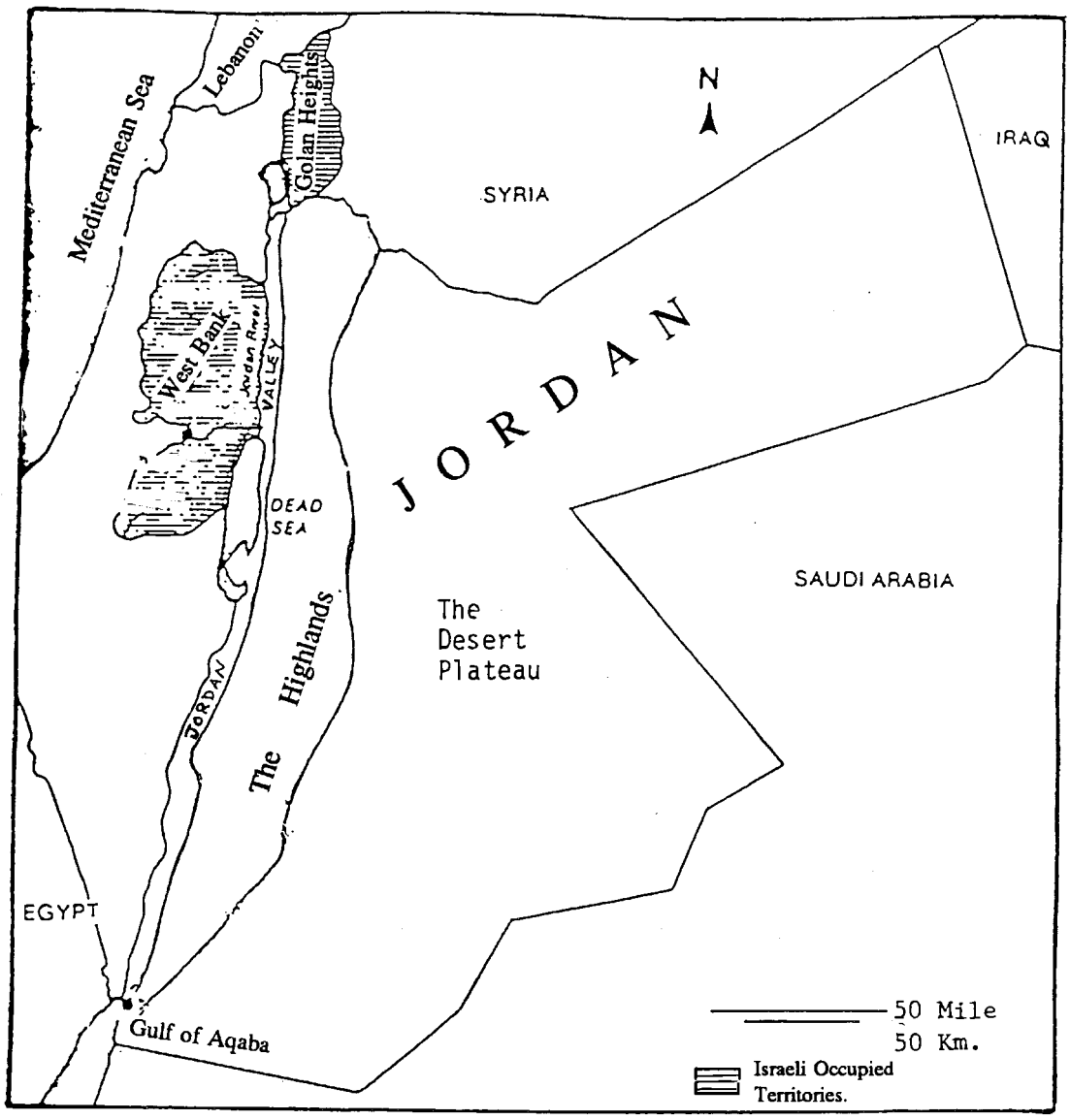

Figure 2.1: Relief Map of Jordan.

the Jordan River and some other wadis[12] (creeks) which drain into the River. The precipitation in the Jordan Valley is very low; it receives about 150 to 250 millimeters (or 5.91 to 9.85 inches) per annum (Saket 1985, 10). Another characteristic of the Jordan Valley is its high temperatures during summer and its warm temperatures during winter.

2.1.2 The Highlands

The highlands are those which overlook the Jordan Valley from the east. It extends from north to south where its elevation reaches on an average about 1200 meters above sea level. The elevation increases as one moves towards the south where it reaches more than 1500 meters on an average above sea level (Saleh 1991, 18-19).

2.1.3 The Desert Plateau

The eastern and southern part of Jordan is mainly desert. It occupies about three-fourths of Jordan's area. This area is replete with volcanic formations, thus rendering the soil unsuitable for cultivation. Precipitation is very low in this area: less than 100 millimeters (3.94 inches) is received annually. During winter, some small streams flow into it hence replenishing the underground water table. During summer those

[12] It is a plural of wadi. It is an Arabic name that refers to the bed area where water flows during winters and are mostly dry during summers. These are similar to the creeks that are familiar to those in the western United States.

streams turn dry.

2.2 Climate

The climate in Jordan is typically an East Mediterranean, dry and hot during summer season and humid and cold during winter season. In the following section, two climate indicators will be discussed: temperature and precipitation.

2.2.1 Temperature

The average monthly temperature varies depending on the season and the location. During summer, for example, the Jordan Valley and Aqaba has high temperatures. In Aqaba, which is in the extreme south of the country, the monthly average temperature ranges between 28.7 Centigrade to 32.3 Centigrade during the months of May to August of 1989 (see Table 2.1). At Deir Alla, which is in the southern part of the Jordan Valley and in the western part of the country, the monthly average temperature varies between 27.5 Centigrade to 31.5 Centigrade for the period of May to August (see Table 2.2).

During winter, the average monthly temperature in Aqaba, for example, ranges between 11.8 Centigrade and 18.7 Centigrade for the months of December to March, reaching its minimum in the month of January where it is, on an average, about 11.8 Centigrade (see Table 2.1). In the southern part of the Jordan Valley, the average monthly temperature in Deir Alla, for example, varies between 12.1 Centigrade to 17.8

Table 2.1: Monthly Temperature at Aqaba Airport Station During 1989 (Centigrade)

Month	Average Maximum Temperature	Average Minimum Temperature	Average Temperature
January	17.1	6.4	11.8
February	20.5	7.3	13.9
March	25.0	12.3	18.7
April	34.0	18.3	26.2
May	35.9	21.5	28.7
June	37.7	22.6	30.2
July	39.5	24.8	32.2
August	39.1	25.4	32.3
September	36.4	23.3	29.9
October	31.6	19.1	25.4
November	26.9	15.1	21.0
December	21.5	9.3	15.4

Source: Jordan, Department of Statistics (DOS), Statistical Yearbook, 1989, Table (1/16), p. 17.

Table 2.2: Monthly Temperature at Deir Alla Station During 1989 (Centigrade)

Month	Average Maximum Temperature	Average Minimum Temperature	Average Temperature
January	16.2	7.9	12.1
February	19.6	9.1	14.4
March	23.6	11.9	17.8
April	33.9	16.7	25.3
May	35.7	19.3	27.5
June	36.5	20.8	28.7
July	38.9	23.2	31.5
August	38.6	24.2	31.4
September	36.6	23.3	29.9
October	31.6	19.7	25.7
November	26.2	17.4	21.8
December	19.7	11.8	15.8

Source: Jordan, Department of Statistics (DOS), Statistical Yearbook, 1989, Table (1/13), p. 14.

Centigrade for the months of December to March, with the minimum recorded for the month of January where it is 12.1 Centigrade (see Table 2.2). In Amman, for instance, the average monthly temperature ranges between 21.7 Centigrade and 25.5 Centigrade during the months of May to August. It is between 5.6 Centigrade and 11.7 Centigrade during months of December to March (see Table 2.3).

In Irbid, which is in the northern part of the country, for instance, the average monthly temperature ranges between 21.9 Centigrade and 25.1 Centigrade during the months of May to August, while it is between 6.3 Centigrade and 12.2 Centigrade during months of December to March (see Table 2.4).

In Al-Ruwaished, which is in the eastern part of the country, where the average monthly temperature ranges between 24.4 Centigrade and 29.2 Centigrade during the months of May to August, whereas it is between 4.5 Centigrade and 13.0 Centigrade during months of December to March (see Table 2.5).

2.2.2 Precipitation

The level of precipitation fluctuates over the country and is highly volatile. Its meager rainfall is unevenly distributed and depends on the season.[13] In terms of the average annual rainfall, Jordan can be classified as an arid

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[13] Ku'war (1992), the Jordanian minister of water and irrigation, argued that about 85 percent of the rainfall evaporates. Only 5 percent of it replenishes the groundwater basins and the rest (10 percent) appears as a surface water.

Table 2.3: Monthly Temperature at Amman Airport Station During 1989 (Centigrade)

Month	Average Maximum Temperature	Average Minimum Temperature	Average Temperature
January	9.6	1.5	5.6
February	12.8	3.0	7.9
March	16.9	6.5	11.7
April	27.4	13.1	20.3
May	28.6	14.8	21.7
June	29.9	16.3	23.1
July	31.9	18.8	25.4
August	31.8	19.1	25.5
September	30.3	16.8	23.6
October	25.3	13.8	19.6
November	20.1	10.1	15.1
December	14.7	5.1	9.9

Source: Jordan, Department of Statistics (DOS), Statistical Yearbook, 1989, Table (1/8), p. 9.

Table 2.4: Monthly Temperature at Irbid Nursery Station During 1989
(Centigrade)

Month	Average Maximum Temperature	Average Minimum Temperature	Average Temperature
January	10.2	2.4	6.3
February	13.7	4.2	9.0
March	16.7	7.7	12.2
April	27.4	14.0	20.7
May	28.2	15.6	21.9
June	28.8	16.7	22.8
July	31.0	19.4	25.2
August	30.8	19.4	25.1
September	29.4	18.1	23.8
October	24.9	14.6	19.8
November	20.7	11.4	16.1
December	15.0	6.8	10.9

Source: Jordan, Department of Statistics (DOS), Statistical Yearbook, 1989, Table (1/10), p. 11.

Table 2.5: Monthly Temperature at AL-Ruwaished Station During 1989 (Centigrade)

Month	Average Maximum Temperature	Average Minimum Temperature	Average Temperature
January	9.3	-0.4	4.5
February	13.9	0.9	7.4
March	19.7	6.2	13.0
April	29.6	13.1	21.4
May	32.3	16.4	24.4
June	35.1	17.6	26.4
July	37.9	20.4	29.2
August	37.4	20.2	28.9
September	34.0	17.2	25.6
October	28.1	13.0	20.6
November	21.6	8.3	15.0
December	15.8	2.6	9.2

Source: Jordan, Department of Statistics (DOS), Statistical Yearbook, Table (1/12), p. 13.

to semiarid country. The average annual rainfall varies from 50 millimeters to nearly more than 500 millimeters. The areas with the highest rainfall are those rocky mountains near the Jordan Valley-Dead Sea rift. Table 2.6 presents the average annual rainfall and its distribution in Jordan. For example, about 91.4 percent of country area receives less than 200 millimeters per annum while about 8.6 percent of its total area receives between 200 and 500 millimeters annually (see Table 2.6 and Figure 2.2).

In a rainfed agriculture, the fluctuations in the level of annual rainfall can affect the agricultural sector in terms of the kind of crops that can be grown or supported with the limited rainfall (excluding irrigated agriculture). For instance, in the case of Jordan, Qasem and Mitchell (1986) stated that a level of rainfall between 200 and 300 millimeters (mm) per year is suitable for growing barley. Also a level of rainfall between 300 and 350 millimeters annually is suitable for growing barley and legumes with relatively good success, while wheat and olives with less success. Also an average annual rainfall of 350 to 400 millimeters can support growing crops such as stone fruits, olives, wheat, barley, and legumes. An average annual rainfall of 400 millimeters or higher can support growing crops such as lentils, chickpeas, tomatoes, okra, water melon, tobacco, in addition to those crops already mentioned in the group of 350 to 400 millimeters per year. On the other hand, a range land

Table 2.6: Average Annual Rainfall and Its Distribution In Jordan

Rainfall[a] (millimeter)	Area[a] (Square Kilometers)	Of Total Area (Percentage)
50	59,327	64.10
50 - 100	13,851	14.97
100 - 200	11,395	12.31
200 - 300	3,948	4.27
300 - 400	1,788	1.93
400 - 500	1,253	1.35
More than 500	989	1.07
Total	92,551	100.00

Source:

a) FAO, Regional Study on Rainfed Agriculture and Agroclimatic Inventory of Eleven Countries in the Near East Region, Rome, 1982, p. 54.

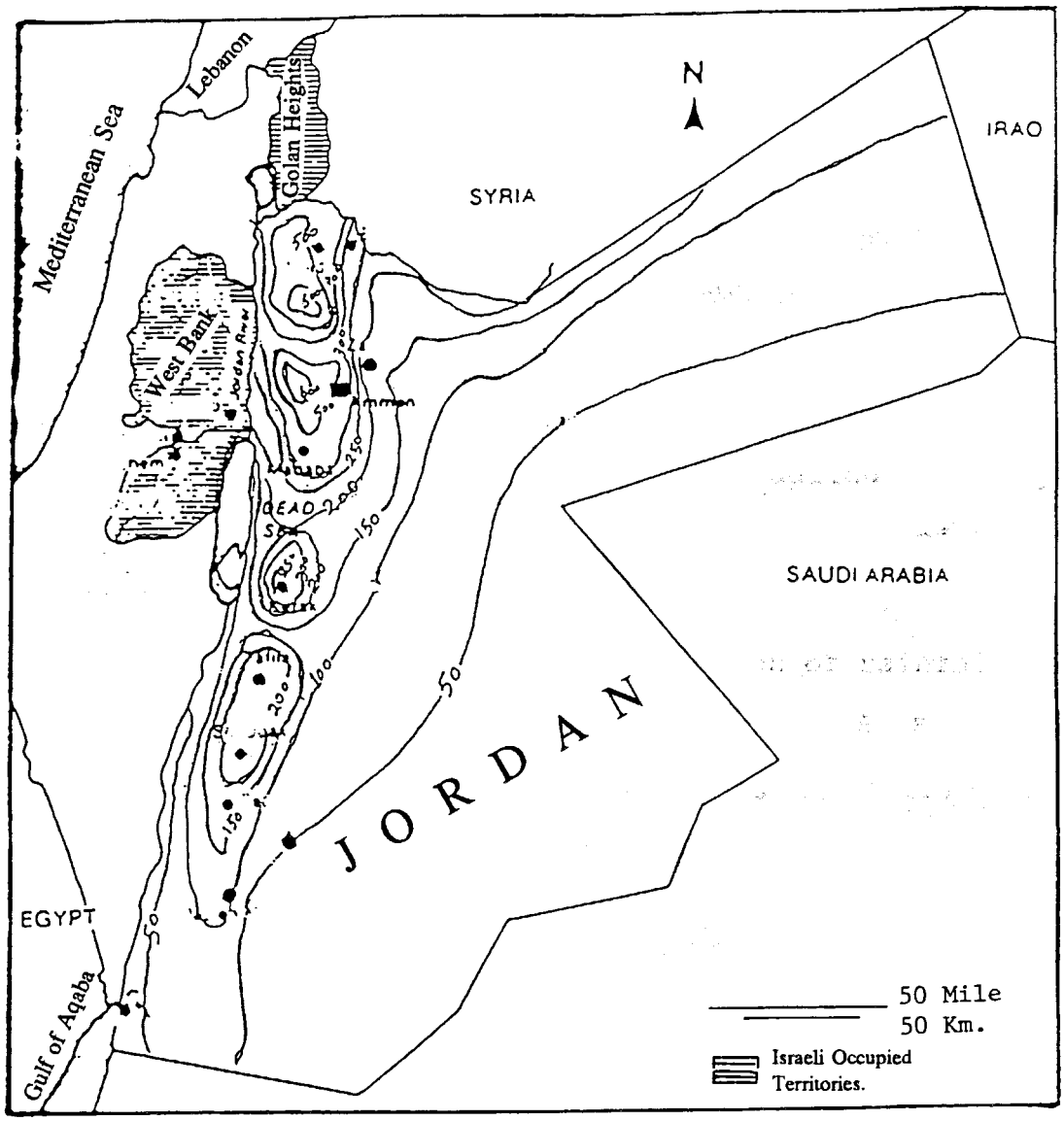

Figure 2.2: Distribution of Rainfall in Jordan.

(except irrigated areas) covers those areas with less than 200 millimeters per year.

Table 2.7 shows monthly and seasonal amounts of rainfall registered for selected years in Jordan. It reveals that the rainy season for the periods of 1954-1962 and 1988-1989 extends from October to May. For instance, during the period 1954-1962, the average rainfall was high during the months of November to March with the highest level of rainfall registered in the months of December and January (76.4 and 82.8 millimeters, respectively). Whereas during the period of 1988-1989, the average rainfall was high during the months of December to March, with the highest level of rainfall registered in the month of December (88.05 millimeter).

On a regional level, the distribution of rainfall varies among different regions, as shown in Table 2.8. For example, the maximum rainfall occurs in the eastern hills where it receives on an average about 500-600 millimeters (19.7-23.64 inch) annually, while the Jordan Valley receives an average of 200 millimeters (7.88 inch) per year. On the other hand, the Jordanian desert, which forms most of the country's area, receives less than 100 millimeter (3.94 inches) on an average annually (see Table 2.8).

The shortage in rainfall affects the agricultural sector directly and the underground water tables. Additionally, this lack of rainfall alters the runoff of rivers and springs which ultimately cause a shortage in meeting the demand for water by

Table 2.7: Average Monthly Rainfall In Jordan
For Selected Years
(in Millimeters)

Month	Average Rainfall[a] (1954-1962)	Average Rainfall[b] (1988/1989)
October	4.0	7.43
November	39.8	12.41
December	76.4	88.05
January	82.8	39.58
February	60.6	32.17
March	46.8	36.31
April	16.1	0.71
May	6.0	0.04
Total	332.5	216.70

Sources:

a) Natur, Fahd Salih, "Water Supply for the Agricultural Sector," In: Agricultural Sector of Jordan: Policy and Systems Studies, Edited by: A. B. Zahlan, London: Ithaca Press, 1985, Table 7.1, p. 199.

b) Jordan, Department of Statistics (DOS), Statistical Yearbook, 1989, Table (1/1), p 2.

Notes:

1) These two columns are not necessarily comparable since the data for the period 1954-1962 are given for all stations, whereas those for 1988/1989 are given for 29 stations.

2) The data for months of June to September are not available. However, it is very rare that it rains in these months.

Table 2.8: Average Annual Rainfall by Region
(in Millimeters)

Region	Average Annual Rainfall
Jordan Valley	150 - 250
Eastern Hills	500 - 600
Desert	less than 100

Source: Saket, Bassam, "The Jordanian Economy," In: Agricultural Sector of Jordan: Policy and Systems Studies, Edited by: A. B. Zahlan, London: Ithaca Press, 1985, p. 10.

the domestic and industrial sectors.

2.3 Summary

Overall, one can conclude that Jordan suffers a shortage of its water supply, given its modern, urbanized mix of economic activity and current methods of distribution. The increase in water demand and the limited water supply due to low levels of rainfall and the high temperatures during summer, which lead to high evaporation levels, contribute to the problem of water shortages in Jordan. This predicament primarily stems from Jordan's geographical/ climatological conditions that are principally arid to semiarid which is typical of all East Mediterranean climate.

Having now discussed Jordan's topographical/ climatological conditions, I now turn to a brief overview of Jordan's history and economic performance.

CHAPTER 3

HISTORIC AND ECONOMIC BACKGROUND OF THE REGION

Undoubtedly water is one of the essential elements of life for human beings, animals, and plants. About 75 percent of the earth is covered with water. Historically, water resources have played an important role in forming civilizations. Basically, the great civilizations that were settled on the banks of rivers and near waterways. For example, the civilization of Egypt was historically and is now settled on the banks of the Nile River; the civilization of Mesopotamia was established between the Tigris and Euphrates rivers; and the old civilization of Yemen was also settled on an area rich in its water resources.

Beyond this, water resources have also political and legal dimensions that are reflected in water rights and riparian laws. The political and the legal dimensions are so crucial that it triggers, in some cases, continuing state of animosity and tension among countries that are scarce in water resources. An example of this is the tension that occurred between Israel and Arab countries, particularly Jordan, Syria, and Lebanon on one hand and between Turkey and Iraq and Syria on the other hand.

This chapter will discuss first the historical background of Jordan. Here I will briefly discuss the inhabitants of Jordan and their management of water resources. Then in the second part I will examine the economic conditions of the country by focusing on factors such as growth and performance, population, labor force and employment, agricultural sector, industrial sector, and services.

3.1 Historic Background

The area surrounding the Jordan River, connecting Lake Tiberias (The Sea of Galilee) in the north to the Dead Sea in the south has been the crucial interface among Europe, Africa and Asia since the prehistoric period. The ancient empires passed through the area on their way to glory or defeat. Probably major climatic changes from prehistorical times to this date have made the land more or less hospitable to some of the people whether passing through in relatively short periods of time or remaining for millennia, or coming, going, and returning again.

Modern archaeologists are discovering more about the history of the area during the Bronze Age, which ended c.1200 B.C.E. There were by the end of the period a number of city states, largely and for long periods of time dominated by the Egyptians. The passage of time saw the slow rise to power in the area by the Israelites reaching a high point under Solomon. The Israelite Kingdom, however, was soon broken apart

by internal dissention and the area was devastated by the Assyrians and the Babylonians with some measure of stability restored by the coming of Alexander the Great (c.320) and the formation of the Seleucids Empire by the successors of Alexander. The Romans finally consolidated the region before the beginning of the Christian era, initiating another long period of prosperity followed by a decline as the Empire shifted from the west to Byzantium. This long period finally ended with the arrival of the Arabs (c.630 C.E.). Once again there was a period of development followed by along decline. The latter part of this period was consumed with yet another long conflict with the West--the crusader (c.1100-1250 C.E.).

Once again the power center shifts toward Africa as the period of Mamluk dominance begins with its center in Cairo (c.1260). The final wrenching event was the overwhelming of the area by the Ottoman Turks and once more the area is controlled from Byzantium--now called Istanbul. The Ottoman period lasted from c.1520-1917 and ended with the return of the European after World War One.

So we can see in the history of this small area the interface of the great societies of Asia, Africa, and Europe. Somehow, it has survived by adapting to the ebb and flow of civilization and events and has managed to maintain a rough, imperfect, and sometimes tenuous continuity.

Certain historical developments in agricultural use stand out. During the prehistoric period hunting, herding, and

agriculture were the principal activities. The studies and the archaeological excavations showed that the people had settled in the Jordan Valley and Yarmouk River basin before 6000 B.C.E. Irrigation projects were undertaken and waters of the wadis and the streams were harnessed in the area of the Jordan Valley by that time. It is also suggested that Jericho[14] is the oldest city where irrigated agriculture was undertaken.

Khouri (1981) argued that agriculture was introduced into the Jordan Valley about 9000 years ago, and that there were irrigation facilities in the Valley beginning 4500 years ago. In the earliest period, the Jordan Valley was the most populated in the area. This was due to its fertile land and abundant water resources where the Jordan River and its tributaries, mainly the Yarmouk and Zerqa Rivers along with side wadis that flow into the Valley from the eastern hills (see Figure 2.1), which make it suitable for people to settle in that area. In the northern part of the Jordan Valley the annual rainfall on average is about 380 millimeters (15 inches), whereas in the southern area the annual rainfall on average decreases to about 100 millimeters (4 inches) or less (see Figure 2.2). Also, the warm temperature during winter time (about 15 to 22 Centigrade between November and March) has its effect in leading people to settle the Valley.

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[14] The archaeological surveys in the Jordan Valley show that Jericho is the oldest city of the world where people settled down and depend on agriculture and raised livestock as their profession (Khouri 1981, 25). Jericho, nowadays, is a city in the West Bank of the Jordan River.

During the Bronze Age[15] (3000 B.C. to 1200 B.C.), on the other hand, agriculture and trade were the most characteristic of productive activities of the people living there. It is also believed that there were about 300,000 people who dwelled in the area.

The Roman era (62 B.C. to 330 A.D.) showed highly developed agriculture and irrigation systems in the Jordan Valley with emphasis on aqueducts and canals. Dams were constructed and cisterns were dug throughout the Valley.

The Nabataeans, who were roughly independent until completely integrated into the Roman Empire, displays remarkable irrigation and water storage systems.

During the early period of the Arab dominance, Jordan flourished economically and politically because of its importance along the great trading routes. During that period, the area experienced new development in irrigation systems, and utilization of cisterns and springs. During the Ummayad period, of the early Arab dominance, there were canals and reservoir networks constructed in part of the Jordan Valley. In addition, the Mamluk period indicates that there was an abundance of water. There were sufficient water to irrigate sugar cane farms and to operate the sugar mills. When Jordan

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[15] The archeological excavations in the region showed that the Bronze Age (about 2300 to 2000 B.C) was the period when a very advanced agricultural economies and an organized political systems were founded by the people settled the area (Shwadran 1959, 11).

became part of the Ottoman Empire,[16] Turkish rules were applied in the region, and Jordan became less important as a trading route and its overall economic significance, especially in agriculture, declined because of the development of the shipping sector (Phillips 1954, 12-26; Vine 1987, 11-45; and Khouri 1981, 21-67).

During the Ottoman period, Jordan was part of what was called "Greater Syria." The water laws that were in effect during the period of Ottoman Empire were based on the "Mejelle Civil Code"[17] which was translated into Arabic (Caponera 1954, 90-91). After World War One, Transjordan was formed. In 1946 Transjordan became officially the "Hashemite Kingdom of Jordan." Until its independence Jordan used the "Mejelle Civil Code" as a base for its water legislation. New water laws have been enacted since independence (Caponera 1954, 137).

The issue of the riparian states has its effects on water resources usage in Jordan. As a riparian state, besides the other states such as Syria, Lebanon, the occupied West Bank and Israel, Jordan has difficulty in harnessing its share or quota of the waters of the Jordan River basin. The water of the Jordan River basin is vital to Jordan's economic growth

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[16] Jordan was under the rule of Ottoman Empire from 1516 A.D. until 1917 when the Arabs, under the command of Sharief Mecca al-Hussein bin Ali, revolted against it and captured Aqaba, a port city in southern Jordan, in 1917 with the assistance of "Lawrence of Arabia," a British officer (Vine 1987, 44).

[17] The "Mejelle Code" was based on those rules of Napoleonic Code that comply with the Islamic law.

and development. The water is so scarce that it not only hinders Jordan's agricultural development, but it affects the economic development in other sectors as well. Each of the riparian states tries to claim more of the Jordan River basin waters. The dispute among the riparian states over the use of the waters of the Jordan River basin brought up different plans of how to alleviate the problem.

When the Ottoman Empire was in control of Syria and Palestine before the World War One, a plan was suggested in 1913 by the Director of Public Works in Palestine, Georges Franghia, to utilize the water of the Jordan River system in irrigation and generating electricity.[18] Yet this plan was not implemented because of the collapse of the Ottoman Empire as a result of the World War One (Naff and Matson 1984, 30).

After World War One, other plans were proposed to develop the Jordan River system and to mitigate the tensions among the riparian states over exploiting water resources. One of those plans was the one proposed in 1955 by Eric Johnston, a special Ambassador of U.S. President Eisenhower, who was in charge of constructing a plan which was to serve as a comprehensive solution for the dispute over the water of the Jordan River.

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[18] It was suggested by the plan to divert the water of Yarmouk River into Lake Tiberias, construct a canal with an annual flow capacity of 100 million cubic meters to irrigate the Jordan Valley, and build two power plants to generate electricity (Naff and Matson 1984, 30).

The Johnston plan,[19] known as Unified Plan, laid out a proposed scheme for integrated development in the Jordan basin to be followed by the riparian states. This plan involved building dams on the different tributaries, opening gravity flow canals on east and west banks of the river, and developing the Huleh marshes. Furthermore, the plan proposed the allocation of the water of the Jordan River system to be as: 52 percent for Jordan, 36 percent for Israel, 9 percent for Syria, and 3 percent for Lebanon. This plan was not accepted by the Arab League Council. Yet it was used as a general guideline by the states concerned in implementing their own schemes. So, the Johnston Plan was considered more successful one than the other plans[20] that were suggested to alleviate the problem of conflict over Jordan River water (Anderson 1988, 7-10).

In a broadcast interview[21] "Israel: The Water and The Arabs" His Highness, Crown Prince al-Hasan bin Talal (1989),

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[19] Eric Johnston used the "Main Plan (1953)," drafted first by Charles T. Main, Inc., Boston, Massachussets directed by Tennessee Valley Authority under the request of the United Nations, as he started his negotiations in the Middle East to win an agreement among the riparian states on how to develop the waters of the Jordan River System (American Friends of the Middle East, Inc. 1964, 10-52).

[20] The allocation of the Jordan River water was subjected to various plans and attempts to bridge the gap among the riparian states and reach an agreement on how this water should be exploited. Among these plans are, for example, Arab plan and Cotton plan sponsored by the Arab League and Israel, respectively. For more information on the plans for developing the Jordan River system, see for example, American Friends of the Middle East, Inc. (1964), Saliba (1968), Schmida (1983), Lowi (1984), Naff and Matson (1984), Starr and Stoll (1988).

[21] This interview was conducted by the announcer Mrs. Madeha al-Medfa'ai and was broadcasted by Radio London on August 18, 1989; and rebroadcasted on August 20, 1989.

warned of seriousness of the dispute over water resources in the Middle East. His Highness argued that the dispute over water resources in the region could be the main reason triggering a new war between Israel and the Arabs. His Highness added that Israel used more than 95 percent of its renewable resources, and its consumption rate of water is five times more than that of the Arab individual (Talal 1989, 3). In the same interview (Talal 1989), Prof. Thomas Naff[22] argued that there will not be an adequate water supply for Jordan by the end of this century. He added that both countries (Israel and Jordan) used about 115-120 percent of their renewable water resources which threaten the strategic reserves. Jordan, with only two main resources -- the Yarmouk River and the groundwater in al-Disi -- did not have sufficient water resources as Israel has. Professor Naff stated also that:

> this is impossible ideologically and politically since Israel was created on the Zionist Ideology that says: "thinking comes by the way of cultivating the land." (Talal 1989, 7)

3.2 Economic Conditions

This section will briefly discuss the economic conditions of the economy of Jordan in terms of its growth and performance, population, labor force and employment, agricultural sector, industrial sector, and services.

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[22] Prof. Naff is a specialist in the contemporary Middle East history and the director of the Middle East Research Institute of the University of Pennsylvania, Philadelphia in U.S.A.

3.2.1 Growth and Performance

Governmental statistics show that the nominal gross national product (GNP) was 1893.3 million Jordanian Dinars (JDs[23]) in 1985. Then by 1990, it increased to JD 2257.3 million. However, the nominal gross domestic product (GDP) at factor cost was estimated at JD 1664.4 million in 1985 and increased to JD 2250.4 million in 1990 (see Table 3.1). With a population estimated at 3.453 million in 1990, the gross national income per capita reaches about JD 653.72 (see Figure 3.1).

Evaluated in 1985 prices, the real gross domestic product at factor cost reached about JD 1664.4 million in 1985. Then it increased slightly to JD 1696.4 million in 1990 (see Table 3.1 and Figure 3.2).

During the period of 1986 to 1990, the nominal gross domestic product at factor cost reaches its maximum growth in 1989 where its growth rate reached 19.2 percent, then it drops to 0.6 percent in 1990. In other words, between 1986 and 1990, the average annual growth rate in nominal gross domestic product at factor cost was 6.4 percent. Whereas the average annual growth rate of the nominal gross national product was 3.7 percent for the period 1986-1990 (see Table 3.2).

However, the real gross domestic product (GDP) at factor cost has shown some negative growth between 1986 and 1990. For

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[23] The term "JD" stands for Jordanian Dinar, the Jordanian national currency.

Table 3.1: Gross Domestic Product (GDP) and Gross National Product (GNP) in Current and Constant Prices for Selected Years

(in Million Jordanian Dinars (JDs))

	Years					
	1985	1986	1987	1988	1989	1990
Current Prices:						
GDP(at Factor Cost)	1664.4	1701.3	1761.3	1878.2	2238.0	2250.4
GDP(at Producers' Prices)	1898.1	2039.6	2088.5	2201.4	2540.6	2567.4
GNP(at Market Prices)	1893.3	2022.2	2038.3	2112.8	2348.4	2257.3
Constant Prices: (1985=100)						
GDP(at Factor Cost)	1664.4	1728.6	1808.0	1851.1	1804.8	1696.4
GDP(at Producers' Prices)	1898.1	2072.3	2143.9	2169.7	2046.7	1931.1

Source: Jordan, Central Bank of Jordan (CBJ), Monthly Statistical Bulletin 1991, Tables 46 and 47, pp. 80-81.

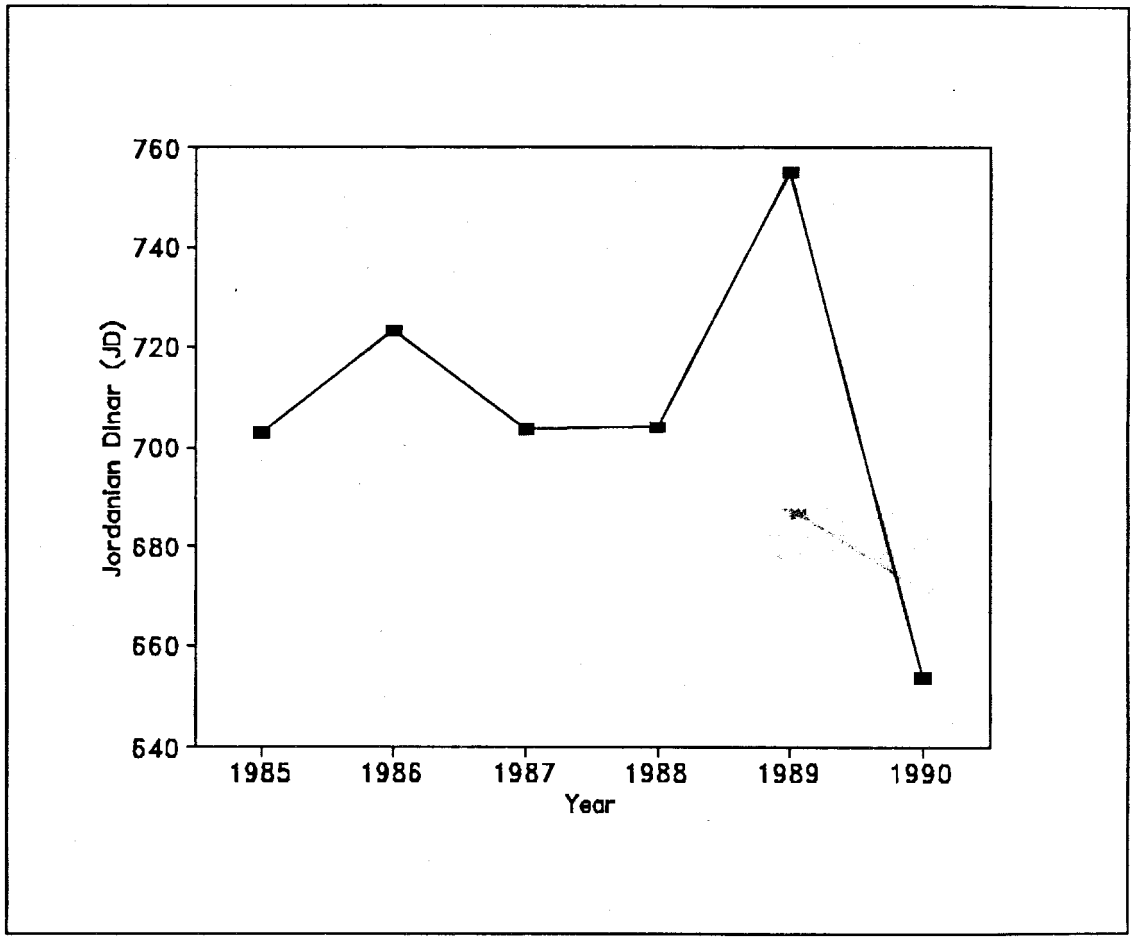

Figure 3.1: Per Capita GNP at Market Prices, Jordan (1985-1990).

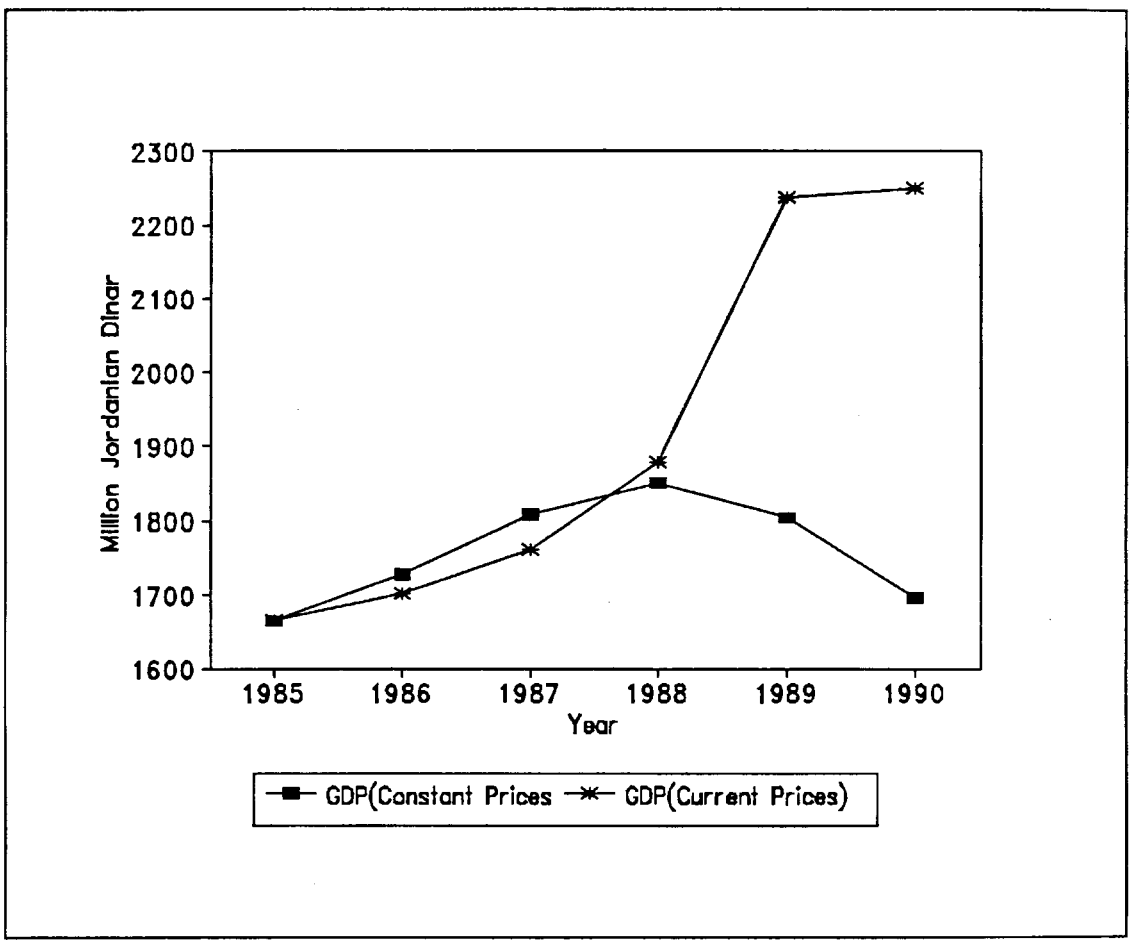

Figure 3.2: Gross Domestic Product at Factor Cost (in Constant and Current Prices).

Table 3.2: Economic Growth Rates of Gross National Product (GNP) and Gross Domestic Product (GDP) in Current and Constant Prices for Selected Years

(Percentage)

	Years				
	1986	1987	1988	1989	1990
Current Prices:					
GDP(at Factor Cost)	2.2	3.5	6.6	19.2	0.6
GDP(at Producers' Prices)	7.5	2.4	5.4	15.4	1.1
GNP(at Market Prices)	6.8	0.8	3.7	11.2	-3.9
Constant Prices:					
(1985=100)					
GDP(at Factor Cost)	3.9	4.6	2.4	-2.5	-6.0
GDP(at Producers' Prices)	9.2	3.5	1.2	-5.7	-5.6

** This Table is based on Table 3.1 above.

example, the growth rate of real GDP at factor cost has declined to 2.5 percent and 6.0 percent for 1989 and 1990 respectively. On average, the annual growth rate in real GDP at factor cost was very low where it was 0.5 percent in the period 1986-1990 (see Table 3.2 and Figure 3.3).

Table 3.3 shows in value terms (Jordanian Dinars) the sectoral contribution to gross domestic product (GDP) at constant factor cost between 1985 and 1990. In 1985, for example, the commodity producing sectors[24] have contributed with JD 527.5 million to GDP, of which about JD 192.9 million from the manufacturing sector.

However, in 1990, the share of the commodity producing sectors in GDP reached JD 627 million, of which the manufacturing sector has contributed with JD 216.4 million.

With respect to the services sectors, its contribution to GDP in 1985 amounted JD 1136.9 million, of which the government services and the wholesale and retail trade have contributed, respectively with JD 316.9 million and JD 290.5 million. Whereas in 1990, much of the GDP have been produced by the services sectors which accounted for JD 1069.4 million of the total GDP (1696.4 million) in that year, where the government services and the financial services have shared with JD 377 million and JD 336.7 million, respectively (see Table 3.3).

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[24] The commodity producing sectors are those of agriculture, mining and quarrying, manufacturing, electricity and water, and construction.

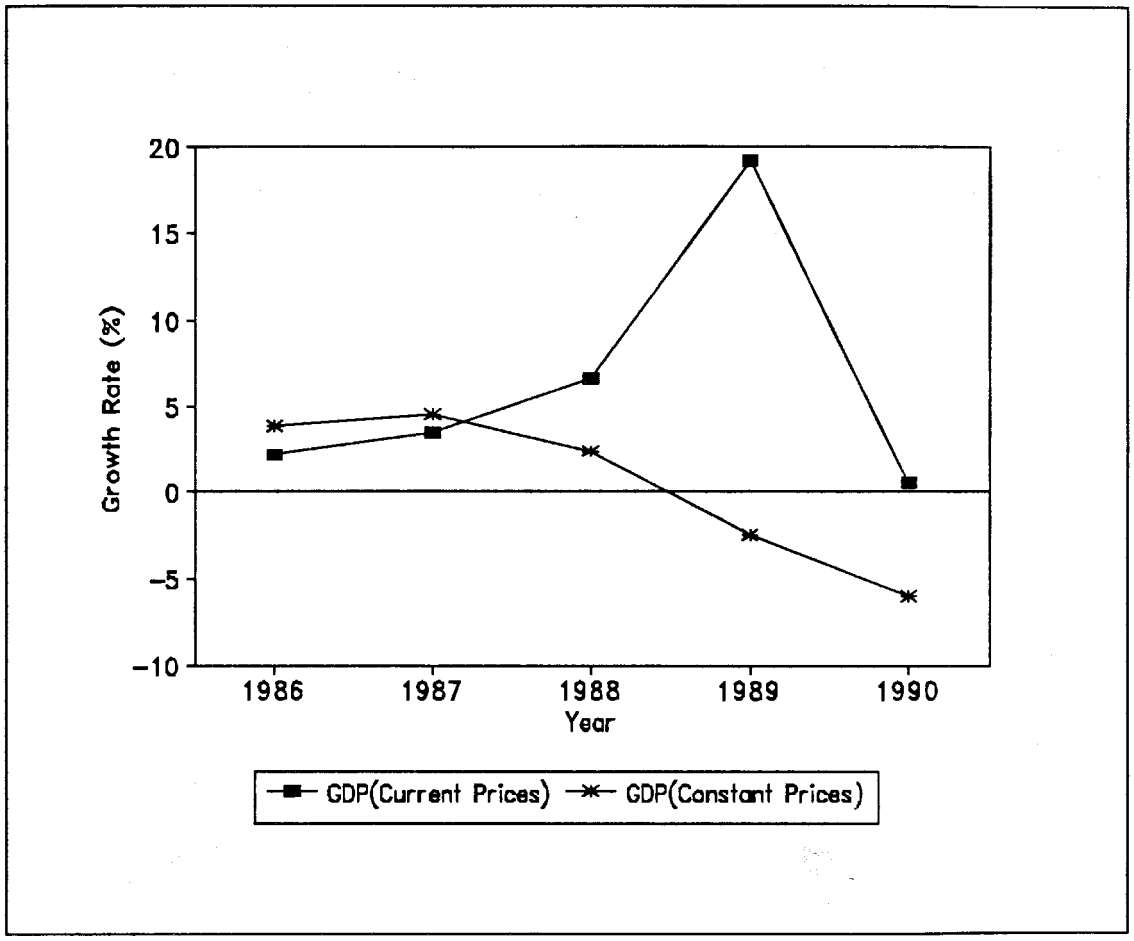

Figure 3.3: Growth Rates of GDP at Factor Cost for 1986-1990.

Table 3.3: Sectoral Contribution to Gross Domestic Product (GDP)
at Constant Factor Cost
(1985=100)
(in Million JDs)

Sector	1985	1986	1987	1988[a]	1989[a]	1990[b]
Agriculture	87.4	90.3	116.4	142.3	123.7	131.2
Mining and Quarrying	62.7	66.4	70.2	68.7	75.5	70.3
Manufacturing	192.9	185.0	192.4	208.9	218.1	216.4
Electricity and Water	40.1	60.8	64.7	64.5	66.3	71.7
Construction	144.4	159.5	147.5	139.7	133.4	137.4
Wholesale and Retail Trade	290.5	271.2	279.4	236.6	235.1	195.4
Transportation & Communication	230.5	242.1	251.5	250.0	228.2	140.3
Finance, Real Estate & Business Services	273.0	290.5	298.3	314.8	328.0	336.7
Government Services	316.9	339.8	364.3	390.7	373.6	377.0
Other Services	26.0	23.0	23.3	34.9	22.9	20.0
GDP at Factor Cost	1664.4	1728.6	1808.0	1851.1	1804.8	1696.4

Source: Jordan, Central Bank of Jordan, Monthly Statistical Bulletin 1991, p.81.
Notes:
[a] Preliminary.
[b] Estimated Figures.

Table 3.4 shows in percentage the sectoral contribution to gross domestic product (GDP) at constant factor cost between 1985 and 1990. In 1985, for example, the commodity producing sectors[25] have contributed with 31.7 percent to GDP, of which about 11.6 percent from the manufacturing sector. In 1990, however, the share of the commodity producing sectors in GDP reached 36.9 percent, of which the manufacturing sector contributed with 12.8 percent.

With respect to the services sectors, its contribution to GDP in 1985 amounted 68.3 percent, of which the government services and the wholesale and retail trade have contributed respectively with 19.0 percent and 17.5 percent. Whereas in 1990, much of the GDP had been produced in the services sectors which accounted for 63.0 percent of the GDP. Government services and the financial services accounted for 22.2 percent and 19.8 percent, respectively (see Table 3.4 and Figures 3.4 and 3.5).

3.2.2 Population

According to the Housing Statistics of August 1952 (Table 3.5), the population size of the East Bank of Jordan was about 586.2 thousands. In 1961 the results of the First Population and Housing Census showed that the population size in the East Bank increased to 900.8 thousand. The results of the Housing

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[25] See footnote 24 for the definition of the commodity producing sectors.

Table 3.4: Sectoral Contribution to Gross Domestic Product (GDP)
at Constant Factor Cost
(1985=100)
(in Percentages)

Sector	1985	1986	1987	1988	1989	1990
Agriculture	5.3	5.2	6.4	7.7	6.9	7.7
Mining and Quarrying	3.8	3.8	3.9	3.7	4.2	4.1
Manufacturing	11.6	10.7	10.6	11.3	12.1	12.8
Electricity and Water	2.4	3.5	3.6	3.5	3.7	4.2
Construction	8.7	9.2	8.2	7.5	7.4	8.1
Wholesale and Retail Trade	17.5	15.7	15.5	12.8	13.0	11.5
Transportation & Communication	13.8	14.0	13.9	13.5	12.6	8.3
Finance, Real Estate & Business Services	16.4	16.8	16.5	17.0	18.2	19.8
Government Services	19.0	19.7	20.1	21.1	20.7	22.2
Other Services	1.6	1.3	1.3	1.9	1.3	1.2
Total GDP	100.0	100.0	100.0	100.0	100.0	100.0
GDP at Factor Cost	1664.4	1728.6	1808.0	1851.1	1804.8	1696.4

Source: This Table is Calculated From Table 3.3 above.

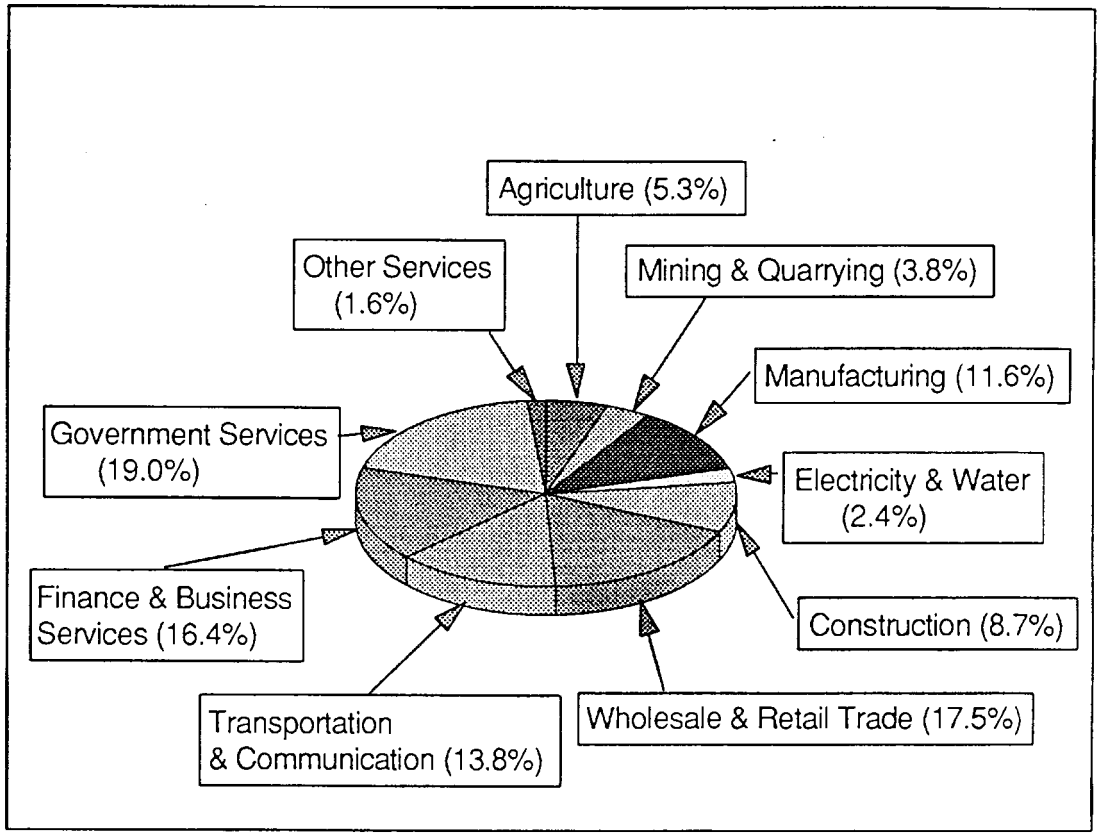

Figure 3.4: Sectoral Contribution to GDP at Constant Factor Cost, 1985.

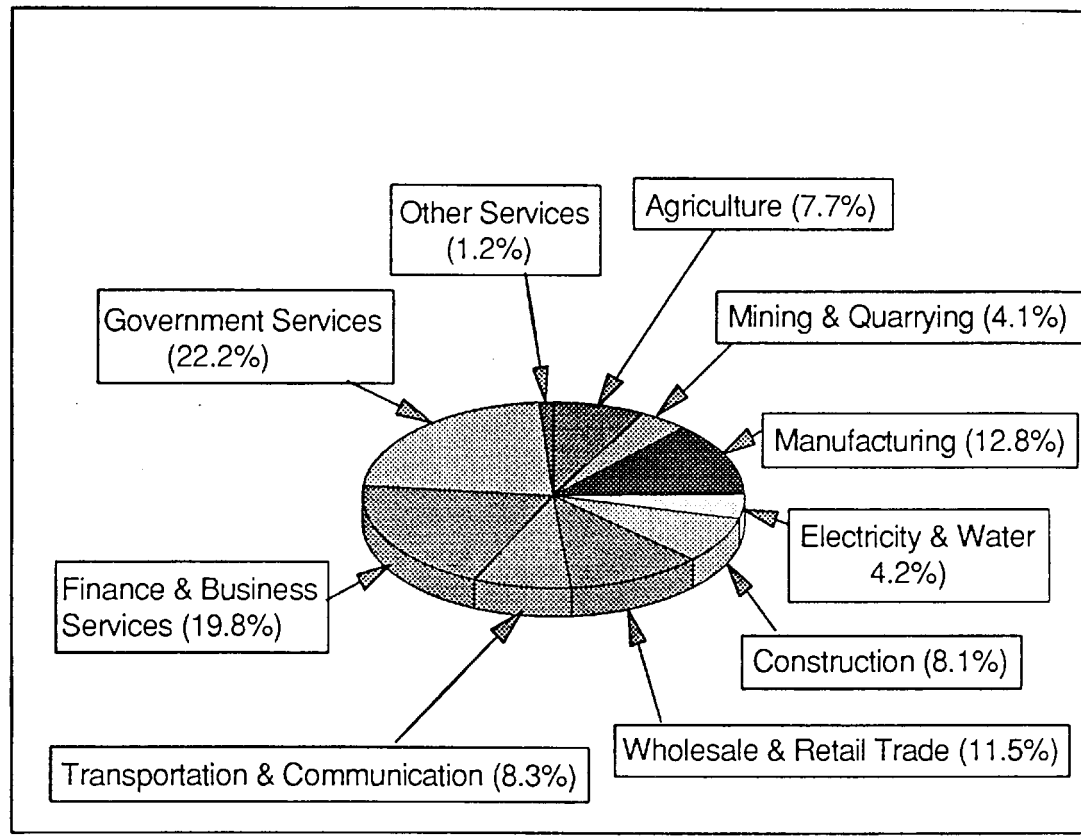

Figure 3.5: Sectoral Contribution to GDP at Constant Factor Cost, 1990.

Table 3.5: Population of The East Bank According to The 1952, 1961, and 1979 Censuses and Estimated Population for Some Selected Years (in Thousands)

Year	Total
1952[a]	586.2
1961[b]	900.8
1965	1028.0
1970	1508.2
1975	1810.5
1979[c]	2133.0
1980	2218.3
1981	2307.0
1982	2399.3
1983	2495.3
1984	2595.1
1985	2693.7
1986	2796.1
1987	2896.8
1988	3001.0
1989	3111.0

Source: Jordan, Department of Statistics (DOS), Statistical Yearbook, 1989, p.19.

Notes:

a Housing Statistics, August 1952.
b Results of the First Population and Housing Censuses on November 18, 1961.
c Results of Housing and Population Census on November 10, 1979.

and Population Census undertaken on November 1979 showed that the population increased to about 2.133 million. These results showed that the population size more than doubled between 1961 and 1979. This increase in population in the period of 1961-1979 was mainly due to the dislocation of the Palestinians by the Arab-Israeli wars in 1948 and 1967. Many people fled their homes into Jordan from Palestine to escape the harms of the Israeli occupation and the destruction of these wars.

As shown in Table 3.6 about 41.69 percent of the population in 1989 were concentrated in Amman Governorate.[26] It is followed by Irbid Governorate where about 24.21 percent of the population were concentrated. About 1.47 percent of the population are concentrated in Tafiela Governorate, the smallest governorate in terms of population distribution.

3.2.2.1 Labor Force and Employment

The Jordanian economy has suffered setbacks since its inception. The Arab-Israeli Wars of 1948 and 1967 have left their marks on the Jordanian economy. The influx of the Palestinian refugees into the West Bank and Jordan as a result of 1948 War, and then the other wave of refugees who fled the war into Jordan as a result of 1967 War has put excessive burdens on the economy of Jordan in the form of increasing the demand for more housing, schools, and other infrastructure.

Another major loss to the economy of Jordan was in the

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[26] A governorate is the equivalent of a state in the U.S.

Table 3.6: Estimated Population by Governorate
at The End of 1989
(in Thousands)

Governorate	Total	% of Total[a]
Amman	1297.1	41.69
Zerqa	449.9	14.46
Irbid	753.4	24.22
Mafraq	109.0	3.50
Balqa	214.7	6.90
Karak	132.8	4.27
Tafiela	45.8	1.47
Ma'an	108.3	3.48
Total	3111.0	100.00

Source: Jordan, Department of Statistics (DOS), Statistical Yearbook, 1989, p.21.

Note:

[a] This column is calculated from the second column.

agricultural sector where the agricultural production has declined as a result of the Israeli occupation of the West Bank, the most fertile land in the country at that time. Besides, the Jordanian economy suffered another major disruption in its tourist sector because of the 1967 War. Before the war the tourist industry was a major source of revenue to the economy since many tourists used to visit Jerusalem and other holy cities in the West Bank such as Bethlehem.

Based on governmental sources, the Jordanian labor force on the East Bank increased from 218 thousands in 1961 to 405.3 thousand in 1979 (see Table 3.7). Then it increased to 502.4 thousands in 1985, and to 630.1 thousands by the year 1990. As a percentage of the population, the labor force was 24.2 percent in 1961, then decreased to 19.0 percent in 1979. In 1985, it was 18.6 percent, and by the year 1990, it was 18.2 percent (see Table 3.7). This decrease may be attributed to the group of people who are young enough to be considered in the age requirements for the labor force.

As Table 3.8 shows, the distribution of labor force among major economic sectors changed between the years 1961 and 1989. For example, the agricultural labor decreased from about 73 thousands or 33.5 percent in 1961 to about 47 thousands or 11.5 percent in 1979, and then to 38 thousands or about 7.2 percent in 1989. This decrease in the contribution of the labor force in agriculture was partly due to the loss of most

Table 3.7: Population, Labor Force, and The Labor Force as a Percentage of Population in Jordan During the Period 1961-1990 (in Thousands)

Year	Population	Labor Force	Labor Force As a Percentage of Population
1961 [a]	900.8	217.84	24.2
1975	1811	355.4	19.6
1976	1889	367.2	19.4
1977	1972	379.5	19.2
1978	2058	392.2	19.1
1979	2133	405.3	19.0
1980	2218	420.0	18.9
1981	2307	435.4	18.9
1982	2399	451.2	18.8
1983	2495	467.7	18.7
1984	2595	484.7	18.7
1985	2694	502.4	18.6
1986	2796	535.4	19.1
1987	2897	555.7	19.2
1988	3001	572.2	19.1
1989	3111	583.5	18.8
1990	3453	630.1	18.2

Source: Central Bank of Jordan, Monthly Statistical Bulletin, Vol. 27, No. 11, November 1991, p. 4-5.

Note: [a] Ministry of Planning, Five Year Plan For Economic and Social Development (1986-1990), Table 3, p. 63.

Table 3.8: Distribution of Jordanian Active Labor Force By Major Economic Activity for Selected Years, 1961-1989

Economic Activity	1961[a]		1979[a]		1981[b]		1982[b]		1983[b]		1984[b]	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Agriculture	72977	33.5	46728	11.5	38993	9.3	35798	8.3	32813	7.4	34850	7.6
Mining & Manufacturing	22278	10.2	34935	8.5	39286	9.4	41887	9.7	44567	10.1	47414	10.3
Electricity & Water	925	0.4	2472	0.6	3138	0.8	3584	0.8	4052	0.9	4585	1.0
Construction	22187	10.2	52645	13.0	52465	12.5	52596	12.2	52670	11.8	52733	11.5
Trade	17452	8.0	41541	10.3	43260	10.4	44349	10.3	45458	10.2	46497	10.1
Communications & Transportation	7624	3.5	28977	7.2	33219	7.9	35712	8.3	38379	8.6	41178	9.0
Financial Services & Insurance *	--	--	8673	2.1	10585	2.5	11746	2.7	13045	2.9	14444	3.2
Social Services, Public Administration and Defence	7498	34.2	189303	46.7	197434	47.2	206153	47.7	214244	48.1	216848	47.3
Total	217840	100.0	405274	100.0	418380	100.0	431825	100.0	445228	100.0	458549	100.0

Table 3.8 Continued

Economic Activity	1985[b] No.	%	1986[c] No.	%	1987[c] No.	%	1988[c] No.	%	1989[d] No.	%
Agriculture	36883	7.8	37436	7.6	37736	7.4	39658	7.6	37692	7.2
Mining & Manufacturing	49869	10.6	52706	10.7	53556	10.5	53747	10.3	54445	10.4
Electricity & Water	5195	1.1	5418	1.1	8536	1.7	8349	1.6	7329	1.4
Construction	51947	11.0	49183	11.0	53360	10.5	52182	10.0	50780	9.7
Trade	47225	10.0	49258	10.0	49677	9.8	52182	10.0	53398	10.2
Communications & Transportation	44391	9.4	4632	9.4	47107	9.2	46963	9.0	46068	8.8
Financial Services & Insurance	16104	3.4	16748	3.4	16861	3.3	17741	3.4	16229	3.1
Social Services, Public Administration and Defence	220635	46.7	230525	46.8	242511	47.6	250993	48.1	257564	49.2
Total	472249	100.0	492576	100.0	509344	100.0	521815	100.0	523505	100.0

Sources: [a] Ministry of Planning, Five Year Plan For Economic and Social Development 1986-1990, Table 3, p. 63.
[b] Ministry of Labor and Social Development, Yearly Report, 1985, Table 1, Research Department, p. 16.
[c] Ministry of Labor, Yearly Report, 1988, Table 1-1, Research Department, p. 21.
[d] Ministry of Labor, Yearly Report, 1989, Table 1-1, Research Department, p. 19.

Note: * Included in social services.

of the agricultural land in the West Bank as a result of the Israeli occupation in 1967 War. Other factor could be attributed to the movement of labor to other sectors as a result of oil boom in the neighboring Gulf countries such as mining and manufacturing sector, services, and trade.

Despite the increase in the total employment by the mining and manufacturing sector between the years of 1961 and 1979, the percentage of its employment to the total labor force for the same years declined from 10.2 percent to 8.6 percent in 1961 and 1979 respectively (see Table 3.8). Then, it increased to 10.6 percent in 1985, and decreased slightly to 10.4 percent in 1989 (see Table 3.8).

The employment level in the electricity and water sector has shown an increased trend over time. For example, its employment rose from 925 or 0.4 percent in 1961 to 2472 or 0.6 percent, then increased in 1987 to 8536 or 1.7 percent of the total labor force. However, the data for the following years of 1988 and 1989 show a decline in the level of employment in the electricity and water sector in both absolute and relative levels, where it was 8349 or 1.6 percent in 1988, and 7329 or 1.4 percent for the year 1989 (see Table 3.8).

Data in Table 3.8 also show that in the 1980s about half of the labor force were employed by the social and public administration and defence sector. For example, the percentage of the labor force employed by the social services sector increased from 197.4 thousands or 47.2 percent in 1981 to

257.6 thousands or 49.2 percent in 1989 (see Table 3.8). From the above statistics it is evident that the economy of Jordan is predominantly service oriented.

With respect to unemployment in Jordan, the statistics show that the unemployment rate reached its minimum levels in 1976 at 2 percent (see Table 3.9). Earlier, in 1961,[27] the data show that the unemployment rate was 7.1 percent, then increased to about 14 percent in 1967 as a result of the war, which left the West Bank occupied by Israel. Then, in the eighties, the unemployment rate started to rise. It reached 10.3 percent in the year 1989 (see Table 3.9 and Figure 3.6). This was in part due to the domestic and regional recession which began in 1982 (Ministry of Planning, 1986, 59-60).

For the period 1990-1993, the unemployment rate has increased beyond its level in 1989. This increase was mainly due to the Gulf Crisis which erupted in August 1990 between Iraq and Kuwait. In the four-month period following August 1990, it is estimated that 220 thousands Jordanians and Palestinians who used to work in the Gulf countries, especially Kuwait, were forced to return to Jordan (Central Bank of Jordan 1990, 86).

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[27] For additional information, see Mazur (1979).

Table 3.9: The Unemployment Rate in Jordan For Selected Years, 1961-1989

Year	Unemployment Rate (%)
1961[a]	7.1
1967[a]	14.0
1973[a]	8.0
1976[a]	2.0
1981[b]	3.9
1982[b]	4.3
1983[b]	4.8
1984[b]	5.4
1985[b]	6.0
1986[c]	8.0
1987[c]	8.3
1988[d]	8.8
1989[e]	10.3

Sources:
[a] Ministry of Planning, Five Year Plan For Economic and Social Development (1986-1990), p. 59-60.
[b] Ministry of Labor and Social Development, 1985, Department of Research, Yearly Report, p. 15-19.
[c] Calculation is Based on Information Given in: Table 3.7 and 3.8 above.
[d] Ministry of Labor, 1988, Department of Research, Yearly Report, p. 19-21.
[e] Ministry of Labor, 1989, Department of Research, Yearly Report, p. 15-19.

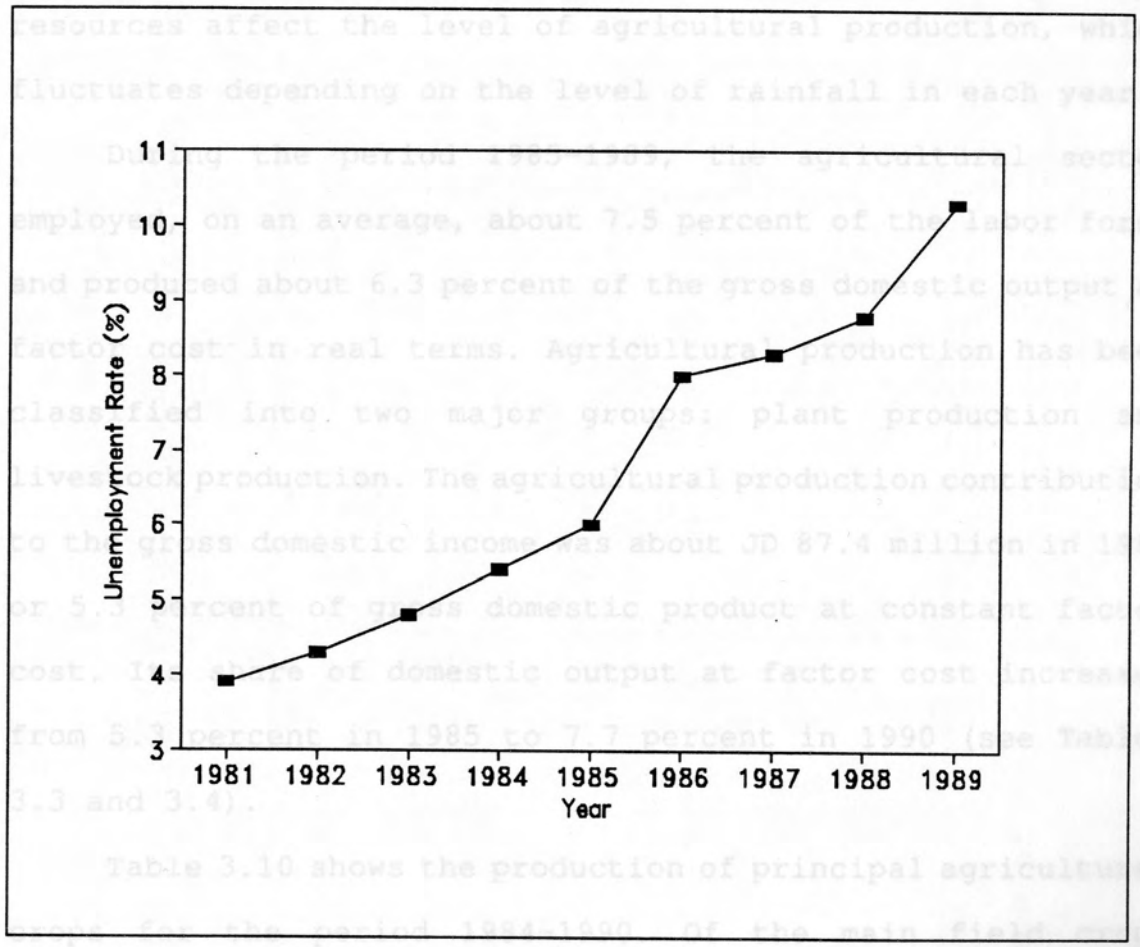

Figure 3.6: Unemployment Rate in Jordan (1981-1989).

3.2.3 Agricultural Sector

Basically, the agricultural production is dependent on rainfall. Its output is mostly the field crops wheat, barley, and lentils. The intermittent rainfall and the meager water resources affect the level of agricultural production, which fluctuates depending on the level of rainfall in each year.

During the period 1985-1989, the agricultural sector employed, on an average, about 7.5 percent of the labor force and produced about 6.3 percent of the gross domestic output at factor cost in real terms. Agricultural production has been classified into two major groups: plant production and livestock production. The agricultural production contribution to the gross domestic income was about JD 87.4 million in 1985 or 5.3 percent of gross domestic product at constant factor cost. Its share of domestic output at factor cost increased from 5.3 percent in 1985 to 7.7 percent in 1990 (see Tables 3.3 and 3.4).

Table 3.10 shows the production of principal agricultural crops for the period 1984-1990. Of the main field crops produced in the country, wheat production has been the highest in the group. Its production has increased from about 50 thousand tons in 1984 to about 83 thousand tons in 1990. However, this total production is not sufficient for local consumption, so the deficits in wheat production have to be covered through imports. The second in production of the field crops is barley. Its total production more than tripled during

Table 3.10: Production of Principal Agricultural Crops
(Thousands of Tons)

	1984[a]	1985[a]	1986	1987	1988	1989	1990[b]
Field Crops							
Wheat	49.7	62.8	30.8	79.8	78.8	54.5	82.9
Barley	11.9	19.7	9.0	33.0	44.9	20.6	42.4
Tobacco	2.5	2.8	1.7	2.9	3.7	2.9	2.9
Lentils	2.5	4.1	1.8	5.2	6.5	1.6	4.1
Vetch	2.1	2.3	1.3	1.3	2.0	1.2	1.4
Chick peas	0.6	1.6	0.6	1.3	1.8	0.1	0.3
Vegetables							
Tomatoes	208.7	251.1	220.6	236.8	218.7	250.4	358.1
Cucumbers	41.9	69.0	64.3	67.2	68.0	53.1	54.3
Eggplants	51.1	57.3	50.6	56.6	72.9	43.8	59.5
Melons	24.4	36.9	66.5	91.3	87.0	66.7	80.5
Cauliflowers & Cabbages	24.7	15.3	41.0	34.2	33.6	23.7	44.3
Broad beans	4.7	6.1	4.4	7.1	4.0	5.4	5.4
Fruit Trees							
Olives	50.0	19.7	31.8	20.4	70.8	25.7	63.7
Grapes	8.6	26.2	23.2	18.6	21.5	21.8	45.7
Citrus Fruits	48.3	81.3	87.4	118.4	101.3	166.7	154.2
Bananas	14.3	10.4	13.4	12.8	33.3	13.4	18.9
Figs	0.3	0.6	1.4	1.3	2.2	2.4	2.4

Source: Central Bank of Jordan, Twenty Seventh Annual Report 1990, p. 154.

Notes: [a] Central Bank of Jordan, Twenty Fifth Annual Report 1988, p. 103.
[b] Preliminary.

the period 1984-1990.

With respect to vegetable production, tomatoes are the major crop. Production fluctuated over the period 1984 to 1990. Its total production in 1990 was about 358 thousand tons.

In the fruit production, citrus production is the major output in that group. It increased from 48 thousands ton in 1984 to 118 thousands ton in 1987. Then the total production increased to 154 thousand ton in 1990 (see Table 3.10). The production of olives has become the second in the total fruits production. It was about 64 thousands ton in 1990 (see Table 3.10).

With respect to livestock production, the poultry (meat and eggs) farm production is predominant in the group (see Table 3.11). However, the domestic production of red meat is not adequate to meet local demand. So the government covers this deficit by importing frozen meat from abroad, particularly from Bulgaria.

3.2.4 Industrial Sector

The industrial sector is comprised of mining and quarrying, manufacturing, electricity and water, and construction. The total production of the industrial sector in constant prices was JD 440.1 million in 1985, of which JD 192.9 million was contributed by the manufacturing sector and JD 144.4 million by the construction sector. In 1990 the

Table 3.11: Livestock Production for 1984-1990
(Thousands of Tons)

Year	Red Meat	Poultry Meat	Milk	Eggs (Million Egg)
1984	9.9	49.0	50.0	390.0
1985	10.9	55.0	56.5	520.0
1986	6.6	63.5	51.7	500.0
1987	8.0	63.0	61.5	425.0
1988	8.3	68.0	66.4	380.0
1989[a]	9.4	43.0	69.4	350.0
1990[a]	9.5	49.0	72.1	530.0

Source: Jordan, Central Bank of Jordan, Monthly Statistical Bulletin 1991, p.83.

Note: [a] Preliminary.

industrial production increased to JD 495.8 million. The manufacturing and construction sectors have contributed JD 216.4 million and JD 137.4 million respectively (see Table 3.3). In other words, the total share of the industrial sector in the domestic income at factor cost increased from 26.4 percent to 29.2 percent in 1985 and 1990 respectively (see Table 3.4).

The industrial sector employed about 22.7 percent of the labor force in 1985, of which 10.6 percent of the labor force were employed in mining and manufacturing. On the other hand, the level of employment by the industrial sector in 1989 had declined to 21.5 percent (see Table 3.8).

Table 3.12 shows the industrial production of the principal industries in the country. Phosphate is the major source of foreign exchange for the country. Its production level amounted to 5748.1 thousand tons in 1990 compared to 6067.1 thousand tons in 1985. Potash production has increased from 908.2 thousand tons to 1415.1 thousand tons in 1985 and 1990 respectively. Also, the production of electricity rose from 1967 million kilowatt per hour in 1985 to 3284.8 million kilowatt per hour in 1990 mainly because of the expansion in the industrial base, the expanding program of electrification of the rural areas in the country, and the expansion in the urban areas and their needs.

Table 3.12: Production of Principal Industries

	Unit	1984[a]	1985[a]	1986	1987	1988	1989	1990
Dry Phosphate	000 ton	6213.1	6067.1	6249.2	6845.4	5628.2	6635.6	5748.1
Potash	000 ton	486.0	908.2	1102.0	1203.2	1298.9	1350.7	1415.1
Cement	000 ton	2026.3	2022.9	1794.7	2371.6	1777.6	1930.0	1738.1
Petroleum Product	000 ton	2510.9	2423.9	2257.1	2404.5	2316.0	2335.1	2593.8
Fertilizers	000 ton	541.0	510.5	551.1	604.0	615.8	602.7	595.8
Chemical Acids	000 ton	1194.6	1007.6	1024.8	1103.2	1157.0	1169.5	1135.5
Iron	000 ton	164.9	198.4	209.6	217.0	194.3	176.5	179.1
Metallic Pipes	000 ton	14.7	14.2	12.5	18.5	15.6	14.0	9.6
Electricity	mill.kwh	1967.0	2154.4	2646.8	3123.8	2887.1	3061.5	3284.8
Cigarettes	mill.cig.	4341.9	3538.1	3327.7	4000.4	3704.2	2791.8	3184.8
Fodder	000 ton	61.2	45.9	44.6	43.7	48.9	50.8	47.0
Alcoholic Drinks	000 liter	7202.0	5547.2	5457.2	5320.0	5490.3	5432.3	6814.4
Detergents	000 ton	25.5	15.0	28.1	25.9	16.8	25.4	32.5
Paper & Cardboard	000 ton	18.0	21.1	15.1	20.5	17.2	22.3	22.6
Textiles	000 yard	1314.5	2249.0	2249.2	1957.9	2136.4	1617.7	1436.7
Spinning	ton	1831.1	1660.3	987.0	2179.8	2002.5	1905.5	1936.3
Upper Leather	000 sq.ft.	2145.7	1937.8	2393.1	2140.6	2133.8	1824.1	1878.3
Sole Leather	ton	43.9	29.3	18.1	34.4	58.1	76.9	87.9
Liquid Batteries	000 batt.	50.1	49.6	55.7	54.4	63.2	68.4	59.5

Source: Central Bank of Jordan, Twenty Seventh Annual Report 1990, p. 156.

Note: [a] Central Bank of Jordan, Twenty Fifth Annual Report 1988, p. 105.

3.2.5 Services Sector

The contribution of the services sector to the gross domestic product in constant prices was JD 1069.4 million, or 63.0 percent in 1990 compared to JD 1136.9, or 68.0 percent in 1985. This decline in the production of the services was mainly due to the reduction in the production level of the wholesale and retail sector, and the transportation and communication sector (see Table 3.3 and Table 3.4).

However, the total employment of the labor force in the services sector increased between 1985 and 1989, from 69.5 percent to 71.3 percent (see Table 3.8). This increase in the employment level was mainly attributed to the social services and public administration sector.

3.3 Summary

In conclusion, it is evident that water has historically been an essential resource for the growth and sustain of the Jordanian economy. As I discussed briefly in the first part of this chapter it is imperative that Jordan claims its water rights from its neighbors such as Israel and Syria. Hence in this context a historical perspective on the riparian laws takes on an added significance.

In terms of population, it is clearly evident that Jordan's population has been affected by both natural and unnatural causes of growth such as the involuntary immigration of Palestinian refugees since the Arab-Israeli conflict in

1948. Another factor that perhaps resulted in this acute population growth is the oil boom resulting from the enhanced economic well-being of households. The impact of all this expansion of population is that it renders Jordan's meager resources even more scarce, thus making it imperative that Jordan develop a highly efficient system of water utilization.

With respect to the agricultural development and its contribution to employment and growth of other sectors such as industry and services, it is once again important that Jordan make efficient use of its water resources by devising a highly effective agricultural policy.

In the following chapter, I will take a close look at the availability of water resources by focusing on the various sources of water supply in Jordan.

CHAPTER 4

WATER RESOURCES IN JORDAN

This chapter will describe the water supply system in Jordan in terms of its availability and sources. Then it will briefly describe other possible of seeking other sources to increase water supply.

Jordan has limited natural resources for its economic development. As pointed out in Chapter 2, Jordan's water supply (surface and groundwater) is mainly dependent on the volume of the annual rainfall which fluctuates widely over the year. The average annual rainfall is between 50 millimeters (1.97 inches) and 600 millimeters (23.62 inches). Most of Jordan's annual rainfall is received on its mountainous areas near the Jordan Valley, Dead Sea , and Wadi Araba. About 91.4 percent of its territory receives less than 200 millimeters (7.87 inches) per annum. The average annual quantity of rainfall in the Jordanian territory is about 7,200 million cubic meters. During dry seasons, the average quantity of rainfall in the Jordanian territory is about 6,000 million cubic meters. In rainy seasons, rainfall reaches about 11,500 million cubic meters. However, 85 percent of this rainfall evaporates. Some of the remaining rainfall flows down rivers,

streams, and wadis as surface water, and the rest seeps into the ground to replenish the groundwater aquifers (Ministry of Planning 1986, 497; Balbesi and Beni-Hani 1990, 35-39).

4.1 Availability of Water Resources

In terms of the availability of water resources, Jordan could be divided into three parts (Water Authority 1985, 1-2): part one includes regions considered to be self-sufficient in water resources, and in some cases even have an excess over their own needs. These regions are Yarmouk basin, Wadi al-Agib, Azraq, Dhuleil, Dead Sea escarpments, Wadi Araba escarpments up to Ra'as en Nagab, AlJafr, Disi and Shadheih, and Mudwarah.

Part two consists of areas having scant water resources. These areas are The Jordan Valley, Greater Amman, and Southern Ghor. In contrast to the previous two parts, part three contains areas that have no water resources of their own. Rather, they are depended on other areas to fulfill their water needs. These are Irbid Governorate and the Aqaba district.

4.2 Sources of Water Supply

A closer examination of the water resources available in Jordan shows that the system of water supply can be divided into the following components: traditional (natural) sources such as surface and ground water, and nontraditional

(artificial) sources such as recycled water and other sources such as desalination and importing water from Iraq and Turkey (see Figure 4.1).

4.2.1 Surface Water

Jordanian surface water resources are considered the main component of its water supply system. Table 4.1 shows the distribution of the surface water resources divided into 13 different basins (see Figure 4.2). As it is evident from Table 4.1, the Yarmouk River basin and Zerqa River basin are the main sources of surface water. It is also clear from Table 4.1 that the average annual base flow of all streams and wadis is estimated at about 434.0 million cubic meters, and the average annual flood flow is estimated at about 289.0 million cubic meters. Hence, the total surface water resources are approximately 723.0 million cubic meters per year of which about 300 million cubic meters come from Yarmouk River basin, and about 92 million cubic meter is from Zerqa River basin. In other words, the Yarmouk River basin and Zerqa River basin supply about 41.5 percent and 12.7 percent respectively of the Jordan surface water[28] (see Figure 4.3).

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[28] However, a current study published by Jordan's Royal Society For The Conservation of Nature shows that out of 477 million cubic meters, the total share allocated to Jordan by the Johnston Plan, Jordan utilizes only 100 to 110 million cubic meters per year from the Yarmouk River and nothing from the Jordan River (Cowell 1993). This decreases the total surface water available to Jordan by 190 to 200 million cubic meters annually. That is, its total surface water amount to 523 to 533 million cubic meters per year. For more information on the Johnston Plan see also Lowi (1984), and Naff and Matson (1984).

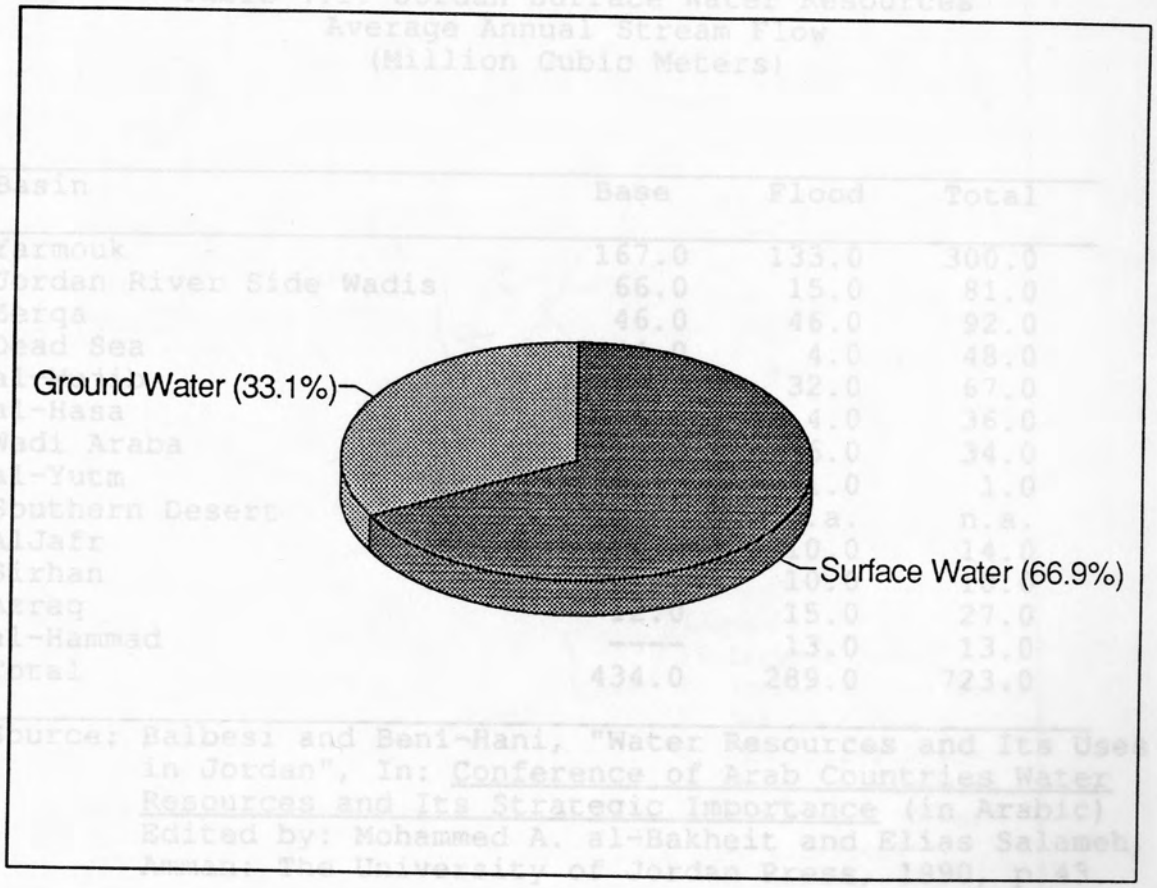

Figure 4.1: Water Supply in Jordan.

Table 4.1: Jordan Surface Water Resources
Average Annual Stream Flow
(Million Cubic Meters)

Basin	Base	Flood	Total
Yarmouk	167.0	133.0	300.0
Jordan River Side Wadis	66.0	15.0	81.0
Zerqa	46.0	46.0	92.0
Dead Sea	44.0	4.0	48.0
al-Mujib	35.0	32.0	67.0
al-Hasa	32.0	4.0	36.0
Wadi Araba	28.0	6.0	34.0
al-Yutm	n.a.	1.0	1.0
Southern Desert	n.a.	n.a.	n.a.
AlJafr	4.0	10.0	14.0
Sirhan	----	10.0	10.0
Azraq	12.0	15.0	27.0
al-Hammad	----	13.0	13.0
Total	434.0	289.0	723.0

Source: Balbesi and Beni-Hani, "Water Resources and Its Uses in Jordan", In: Conference of Arab Countries Water Resources and Its Strategic Importance (in Arabic) Edited by: Mohammed A. al-Bakheit and Elias Salameh, Amman: The University of Jordan Press, 1990, p.43.

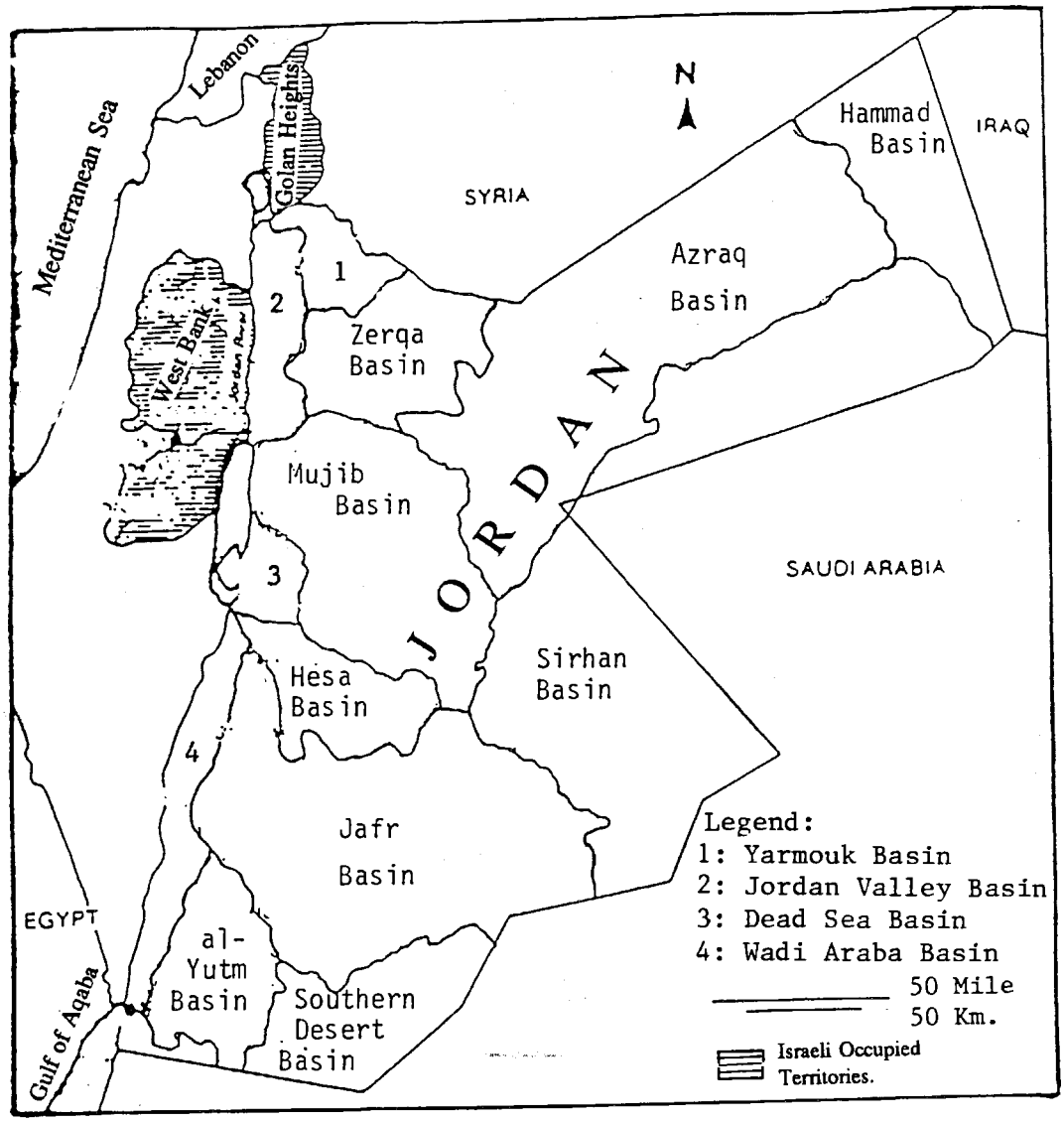

Figure 4.2: Surface Water Basins in Jordan.

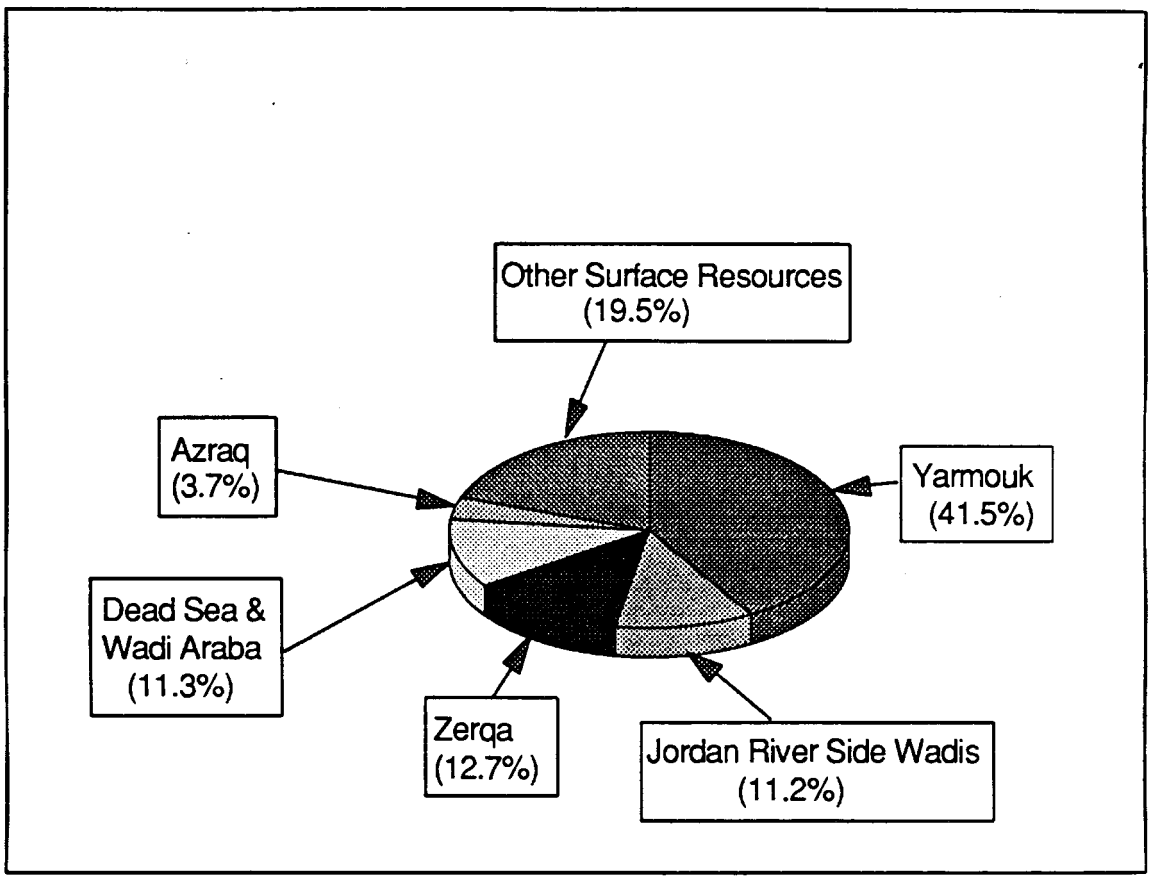

Figure 4.3: Average Annual Stream Flow of Surface Water Resources in Jordan.

In order to mitigate the problem of shortages in its water supply system, and to minimize the loss of flood water, the Jordan government dams its major surface water resources. Table 4.2 shows the erected dams in the country and the principal use of water from the dam until the end of 1990. The gross storage capacity of these fifteen existing dams is 130.5 million cubic meters, which is used for different purposes such as irrigation, energy, groundwater recharge, and livestock. The largest of the fifteen existing dams is the King Talal Dam with a storage capacity of 86.0 million cubic meters. However, the water in this dam is believed to be polluted because of industrial effluents being discharged into the upstreams of Zerqa River. Hence, it is significant to bear in mind that this water is unsuitable for domestic culinary use, and as such, is used for irrigation purposes in the main.[29] More specifically, this water is used to irrigate about 160 thousands dunums[30] of Ghor lands. However, it is now agreed that this water may be contaminated for irrigation purposes as well. Another project is Wadi Al-Arab Dam, with a storage capacity of 20 million cubic meters, which significantly contributes to irrigation in the areas of Northern Ghor. The water here is used to enhance the existing

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[29] Ku'war (1992), the Jordanian minister of water and irrigation, argued that in 1990 Jordan lost about JD 50 million as a result of the polluted water of the King Talal Dam.

[30] A dunum is a unit of area measurement. It is equivalent to 1000 square meters (or 0.0247 acre).

Table 4.2: Completed Dams and Their Uses in Jordan as of the end of 1990 [a]

Dam	Capacity (MCM)	Uses
King Talal	86.0	Irrigation, energy
Kafrein	4.9	Irrigation
Shueib	2.3	Groundwater recharge
Sharhabeel (Ziglab)	4.3	Irrigation
Wadi Al-Arab	20.0	Irrigation, storage, energy
Al Luhfi	0.7	Livestock drinking
Al Aqib	1.4	Groundwater recharge
Al Bowaida	0.7	Livestock drinking
Um el Jimal [b]	1.8	Irrigation & livestock drinking
Al Ghadir Al Abyad	0.7	Livestock drinking
Sama Al Sirhan	1.7	Livestock drinking
Al Sultani	1.2	Irrigation & livestock drinking
Al Qatrana	2.3	Irrigation & livestock drinking
Bourga'	1.5	Livestock drinking
Al-Sha'lan	1.0	Irrigation & livestock drinking
Total	130.5	

Sources:

a) Ministry of Water and Irrigation, Water Authority, Yearly Report (in Arabic), 1990, Table no. 10, p. 25.

b) Saleh, Hassan A. K., "Water Resources and Food Production in Jordan", In: Politics and The Economy in Jordan, Edited by: Rodney Wilson, London and New York: Routledge, 1991, p.36.

level of water in the King Abdullah Canal (formerly East Ghor Canal) during summer in order to irrigate about 12,500 dunums of the Northern Ghor areas (Ministry of Planning 1986, 510).

4.2.2 Ground Water

Ground water resources in Jordan are the second most important supply of water for the country. It has been estimated that the total ground water available to use is 357 million cubic meters per year.[31] Different studies have estimated the total ground water (renewable and nonrenewable) in Jordan at 223-400 million cubic meters per year (Balbesi and Beni-Hani 1990, 47). However, the total renewable ground water resources have been estimated at 275 million cubic meters annually (Water Authority 1985, 2-4).

Jordan is divided into eleven ground water regions (see Table 4.3 and Figure 4.4 and Figure 4.5). This ground water varies in terms of its salinity level. For example, the ground water of the Yarmouk River Basin is of good quality. The salinity level ranges between 280-900 particles per million (PPM). Also, the salinity level of the ground water in the Jordan River basin ranges between 450-800 PPM, whereas that of the Azraq basin is between 300-800 PPM. On the other hand, amongst the highest level of salinity of its ground water are those of the Jordan Valley basin and the Amman-Zerqa basin,

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[31] This total, i.e., 357 MCM includes about 50 MCM, included in the Jafr basin ground water, of the fossil water extracted from the Disi aquifer which is nonrenewable (Balbesi and Beni-Hani 1990, 52).

Table 4.3: Jordan Ground Water Resources
(Million Cubic Meter/Year)

Basin	Available Quantity (MCM/Year)	Salinity Level (PPM)
Yarmouk River	53.0	280 - 900
Jordan River	14.0	450 - 800
Jordan Valley	12.0	800 - 3000
Amman-Zerqa	94.0	400 - 3000
Dead Sea	60.0	500 - 1000
Wadi Araba	8.0	800 - 2500
Red Sea	8.0	700 - 1500
Jafr	78.0	250 - 3500
Azraq	20.0	300 - 800
al-Sirhan	5.0	> 1000
Hammad	5.0	> 1000
Total	357.0	

Source: Balbesi and Beni-Hani, "Water Resources and Its Uses in Jordan", In: Conference of Arab Countries Water Resources and Its Strategic Importance (in Arabic) Edited by: Mohammed A. al-Bakheit and Elias Salameh, Amman: The University of Jordan Press, 1990, p. 52.

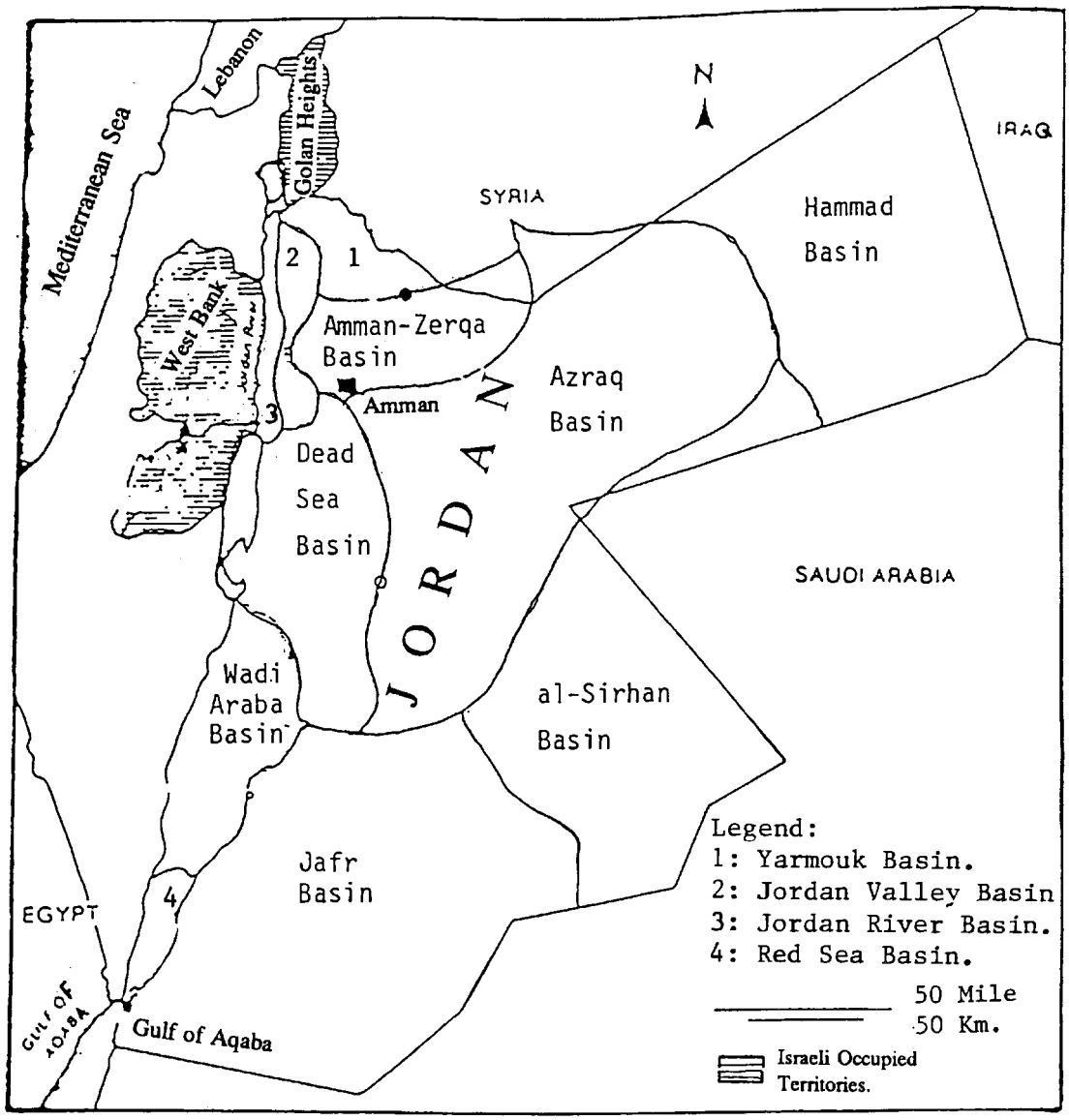

Figure 4.4: Ground Water Basins in Jordan.

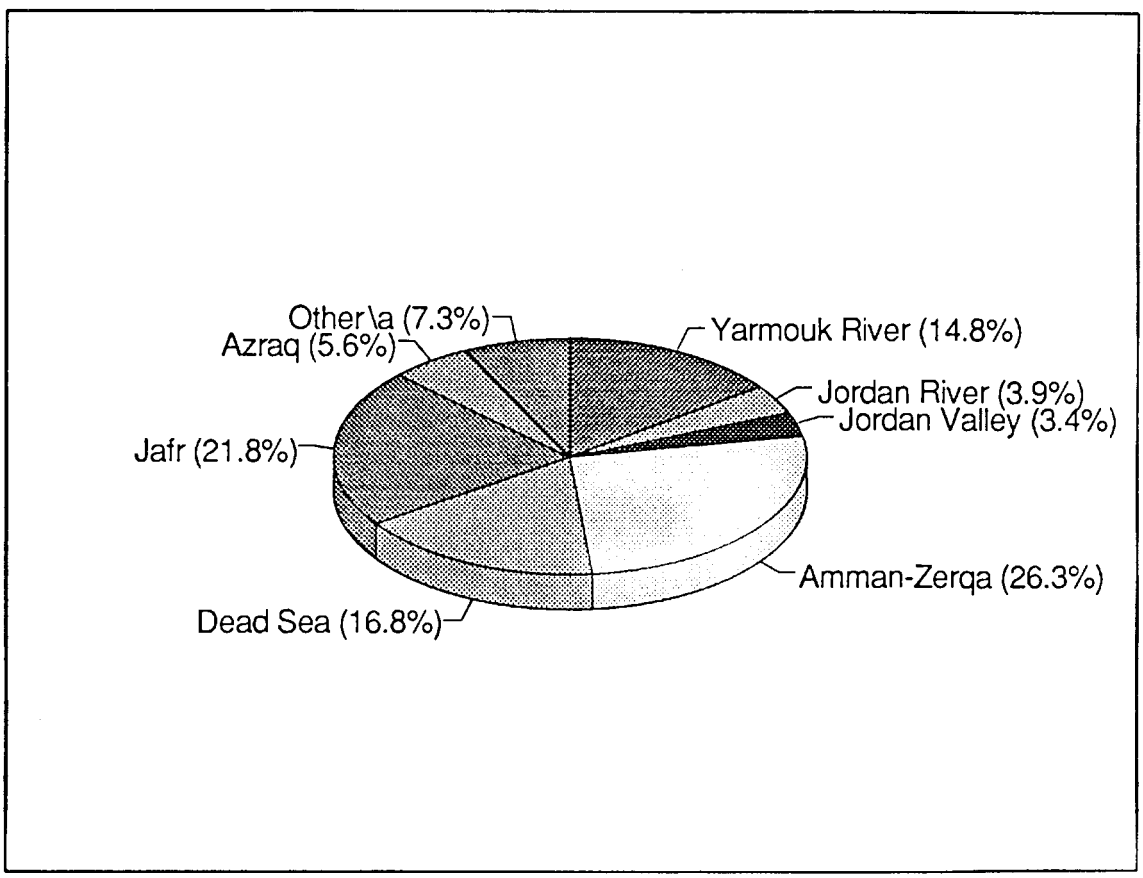

Figure 4.5: Ground Water Resources in Jordan by its Major Basin.

where the level of salinity varies between 800-3000 PPM and between 400-3000 PPM, respectively (see Table 4.3). Recently, the overpumping of water from some of these ground water basins and the intermittent rainfall to recharge the underground water tables have deteriorated the quality of water and increased its salinity level. Thus the high level of salinity affects the quality of water and its uses, particularly domestic and agricultural uses. In general, Al-Weshah (1992), for example, argues that irrigation water with salinity level of 1000 PPM or greater is a problem to most crops. Naff and Matson (1984) argue that a salinity level of 250 PPM or more is too harmful for some crops such as citrus fruits.

The Disi Aquifer system, which occupies the southern part of the country, is probably the most important of the ten ground water regions in Jordan. However, it is essential to bear in mind that this is fossil water: it is nonrenewable. Another limitation of this major ground water source is that it is shared between Jordan and Saudi Arabia, with Saudi Arabia procuring a significant portion of the water for its purposes. For instance, in 1977 Jordan started utilizing the ground water of the Disi Aquifer at Qa' Disi and Sahl Es Sawan at an annual average rate of 5.4 million cubic meters (MCM). In 1983, 1984, and 1985 Jordan had increased its rate of extraction from the same aquifer to an annual average rate of 9.257 MCM, 10.510 MCM, and 12.644 MCM respectively. On the

other hand, in 1983, Saudi Arabia's extraction from the same aquifer was about 6.513 MCM annually, and increased to 56.511 MCM per year and 95.351 MCM per year for the years 1984 and 1985 respectively. A study[32] estimated that Jordan could experience a safe yield of about 110 MCM per year for about 100 years from the aquifer in the Upper Wadi Yutum - Qa' Disi - Sahl Es Sawan - Mudawara (NRA 1988, 147-150).

4.2.3 Recycling Water

As far as artificial sources of water are concerned, water recycling plays a major role in Jordan's water supply system. In order to minimize the effect of shortages in its water resources, Jordan seeks this solution. However, the idea of using recycled water (after mixing it with nonsaline water) in irrigation or replenishing underground water aquifers is controversial, especially in the culture of Moslem countries. Yet, Jordan has a plan to use this source of water in a limited way, at least for irrigating those agricultural products that are consumed as a cooked product. For instance, this water is not used to irrigate citrus or other fruit produce that can be consumed uncooked. Amongst the other Arab countries, Oman is another similar example for using recycled water. Oman uses its recycled water to replenish its underground aquifers (Charnock 1984, 27-28). The advantage, however, in using recycled water for irrigation is that it

[32] This study was done by Howard Humphreys in 1986 (NRA 1988, 164).

makes available more of the good water for municipal as well as for some specific industrial uses. For example, using recycled water in irrigating forage farms will augment the supply of water needed in municipal and industrial sectors by diverting water originally used in irrigation to be used in municipal and industrial sector and replaced it with recycled water. A study performed by the Vappen Byggnas Byran (VBB) in 1977 estimated that the quantity of effluent from Amman to be used in irrigation is given in Table 4.4. According to this study about 95,000 dunums of land could be irrigated by the year 2005 using recycled water from industrial effluent in Amman alone (see Table 4.4).

4.2.4 Other Sources

Other potential sources for enhancing Jordan's water supply are currently being explored by the Jordanian government. One of these options is desalination and the other is to import water from other countries such as Turkey and Iraq. However, both these options (desalination and trading for water) are least viable in comparison to water recycling due to their high economic costs and political infeasibility.

The process of desalinating sea water is highly expensive; the estimated cost of one cubic meter ready for use is about JD 1.5. In contrast, the cost of each cubic meter of the water available from sources other than desalination (recycling, for instance) is at an average of JD 0.25. The plan

Table 4.4: Expected Effluent from Amman Region and the Area to be Irrigated for Selected Years

Year	Effluent (MCM/Year)	Potential Irrigated Area (1 dunum=1000 Sqr.meter)
1980	9	5000
1990	24	14000
1995	35	19000
2000	46	26000
2005	56	31000

Source: Natur, F. S., "Water Supply for The Agricultural Sector," In: Agricultural Sector of Jordan: Policy and Systems Studies, Edited by: A. B. Zahlan, London: Ithaca Press, 1985, p. 208.

to import water from Turkey is called the "peace plan project." According to this plan, water is to be exported from Turkey to the Gulf countries, via Iraq and through the deserts of Syria and Jordan, in exchange for natural gas from the Gulf countries. Recently, there have been talks underway between Jordan and Iraq about another possibility to withdraw water. According to this plan, water will be taken from the Euphrates in Iraq via a canal constructed in the Jordanian eastern desert. This water will then be used to augment the Jordanian water supply system, especially for irrigation purposes. An initial study estimated the cost of this particular project to be roughly JD 2.0 per cubic meter.

However, all these options entail high costs, both economically and politically, and Jordan cannot afford this high cost unless, a) it is shared with others or, b) it receives help (financially and technically) from other countries or international agencies. Politically, the option to withdraw and use water from other nations seems rather improbable given the present political reality of the Middle East. Before these plans could be implemented, it is necessary to settle the endless problem that have arisen in the Middle East such as those that have developed as a result of the Gulf War (1991) and the on-going Israeli-Arab conflict.[33] Hence,

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[33] However, the ongoing peace talks between some Arab states (such as Jordan, Syria, Lebanon, and the Palestinians) and Israel may present the atmosphere suitable for later cooperation in the regional development of water resources in the region.

it is important that reasonable stability in the Middle East is established. Also, given the current situation, the probability of meeting these preconditions does not appear to be very great. Therefore, the current political conditions in the Middle East leaves Jordan with the option of efficiently using (and recycling) its water resources at hand, and settle down the issue of its water rights in the water of the Jordan River basin.

4.3 Summary

In conclusion, it is evident that the Jordan water supply system suffers from both climatological and riparian issues. For example, with respect to the climatological issues, it is clear in the shortages of the rainfall that Jordan receives, where about 85 percent of its rainfall evaporates. On the other hand , the riparian or water rights issues have added to the scarcity of water resources in Jordan.[34] This has been apparent in the case of both the Jordan and the Yarmouk rivers. Jordan currently receives nothing from the Jordan River and between 100-110 million cubic meters per year from the Yarmouk River.[35]

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[34] About 36 percent of Jordan water resources is shared with other contiguous countries with whom Jordan shares unstable relations (Haddadin 1990, 27-28).

[35] The water allotment for Jordan is 477 million cubic meters annually from both rivers, of which about 100 million cubic meters to be received from the Jordan River, and 377 million cubic meters to be received from the Yarmouk River (Cowell 1993).

Therefore, based on the above information, the total annual supply of water in Jordan may be estimated at 830-840 million cubic meters. This includes only about 100-110 million cubic meters which comes from the Yarmouk River. It is also worth mentioning that this total does not include the nonrenewable ground water from the Disi aquifer which amounts at an annual extraction of 50 million cubic meters.

CHAPTER 5

THEORETICAL FRAMEWORK

Natural resources are not evenly distributed all over the world. Endowments of these resources vary among countries. The availability of water as a resource is a prime example of this disparity between countries. The allocation of resources has to be made in a way that will enhance the economic development and the well-being of the people who live in these countries. In other words, each country under such constraints must find a way in which it can best allocate its given and limited resources among alternative production possibilities to satisfy final demand. Jordan is an example of a country that suffers disproportionately from this allocation problem.

This chapter will discuss the Input-Output model as a theoretical framework for the analysis of planning of water resources and its allocation among different sectors in the economy. It will also discuss different types of input-output multipliers such as output multipliers, income multipliers, and employment multipliers. Applications to Jordan's specific problem will be made in the final two chapters.

5.1 Theoretical Model

The Leontief open static model[36] is the theoretical model to be used as a base for the analysis of water use and allocation within the economy of Jordan. In the framework of input-output analysis, the total output produced by each industry is either consumed as an intermediate input by other industries, or, sometimes internally by the producing industry itself, or, by the final demand sector, or both.

The input-output table for a certain country describes the flow of goods and services among different sectors of its economy. The flow of goods and services could be either in physical units or in money terms.

Let there be an economy with n-producing sectors and a final demand sector. We define:

X_i : the gross output of sector *i*;

x_{ij} : the sales of sector *i* to sector *j*;

A : an n x n matrix of technical coefficients;

I : the identity matrix;

Y_i : the final demand for sector i product. Then, the total output of sector *i* will be:

$$X_i = \sum_{j=1}^{n} x_{ij} + Y_i \qquad (5.1)$$

where (i=1, ...,n)

---

[36] For further discussion of the theory, see as examples, Leontief (1953, 1986), Dorfman (1958), and Miernyk (1965).

Let a_{ij} be the technical (input) coefficient which represents the amount (value) of sector i's output needed to produce one unit (one dollar) of sector j's output; thus, using the assumption of constant production coefficient, we get:

$$a_{ij} = x_{ij}/X_j$$

or

$$x_{ij} = a_{ij} X_j$$

which means that the total value of purchases of goods and services by sector j from sector i is $a_{ij} X_j$.

So, for a given target of final demand on goods and services, Y, this relation defines how much each producing sector must produce in order that it will satisfy this bundle of final demand on goods and services, i.e.,

$$\boldsymbol{X = AX + Y} \tag{5.2}$$

So for an economy with "n" producing sectors, the total output of each sector can be written as:

$$\begin{aligned} X_1 &= a_{11}X_1 + a_{12}X_2 + \ldots + a_{1n}X_n + Y_1 \\ X_2 &= a_{21}X_1 + a_{22}X_2 + \ldots + a_{2n}X_n + Y_2 \\ &\ldots\ldots\ldots\ldots\ldots\ldots\ldots \\ X_n &= a_{n1}X_1 + a_{n2}X_2 + \ldots + a_{nn}X_n + Y_n \end{aligned} \tag{5.3}$$

or; by rearranging the above equations we get:

$$
\begin{aligned}
(1-a_{11})X_1 &- a_{12}X_2 - \ldots - a_{1n}X_n &&= Y_1\\
-a_{21}X_1 &+ (1-a_{22})X_2 - \ldots - a_{2n}X_n &&= Y_2\\
-a_{31}X_1 &- a_{32}X_2 + (1-a_{33})X_3 - \ldots - a_{3n}X_n &&= Y_3\\
&\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\\
-a_{n1}X_1 &- a_{n2}X_2 - \ldots + (1-a_{nn})X_n &&= Y_n
\end{aligned}
$$

Written in a matrix form, we get:

$$
\begin{bmatrix} X_1 \\ . \\ . \\ . \\ X_n \end{bmatrix} - \begin{bmatrix} a_{11} \ldots a_{1n} \\ \ldots\ldots\ldots \\ \ldots\ldots\ldots \\ \ldots\ldots\ldots \\ a_{n1} \ldots a_{nn} \end{bmatrix} * \begin{bmatrix} X_1 \\ . \\ . \\ . \\ X_n \end{bmatrix} = \begin{bmatrix} Y_1 \\ . \\ . \\ . \\ Y_n \end{bmatrix} \qquad (5.4)
$$

where:

$X_1, \ldots, X_n$: a vector of output values;
A or $[a_{ij}'s]$: a matrix of technical coefficients;
$Y_1, \ldots, Y_n$: a vector of final demand (in value terms).

or; in a reduced form:

$$
\begin{aligned}
X^* - AX^* &= Y^*\\
X^* &= [I - A]^{-1} Y^*
\end{aligned} \qquad (5.5)
$$

where:

X^* : output vector;
Y^* : final demand vector; and
$[I - A]^{-1}$: the Leontief inverse matrix.

The general solution of equation (5.5) determines how much each sector of the economy must produce in order to satisfy a given level of final demand. For equation (5.5) to have a unique solution in the form of $[I - A]^{-1} * Y$, it is necessary that [I - A] should be a nonsingular matrix, i.e., that the determinant of [I - A] does not equal zero. This assumption leads to the existence of an inverse for the matrix

$[I - A]$.

If we assume that $B \equiv [I - A]^{-1}$, and b_{ij}'s represent the elements of the $[I - A]^{-1}$ matrix. Each element of the $[I - A]^{-1}$ represents the direct and indirect requirements of output of sector i per unit of final demand. In other words, the level of gross output of each sector depends on the level of final demand for the output of all sectors.

5.1.1 Assumptions of the Model

The following assumptions have been used through out the study:

a) The model assumes that there are fixed proportions in all production process. That is, no matter how much the output of certain sector will be, the proportion of each input used in its production process will stay the same. For example, the proportion of goods 1 and 2 as inputs to process 2 is a_{12}/a_{22}.

b) Constant return to scale, i.e, if the output of sector j doubled, then its input from sector i will double too. ($x_{ij} = a_{ij} X_j$).

c) It is also assumed that there are no significant changes in technology over time. So the production structure of the economy will follow the structure of the technological matrix (i.e., matrix A as defined above).

d) When goods are measured in value terms, it is assumed that relative prices are stable.

5.2 Types of Multipliers

For the purpose of this study, three types of multipliers will be introduced. These multipliers are the output multiplier, the income multiplier, and the employment multiplier.[37]

The output multiplier shows which sector of the economy will have the highest impact in terms of total dollar value of output generated from certain spending. It can be found by summing up each column of the Leontief inverse matrix ($[I - A]^{-1}$). So in this case we will have output multiplier for each industry in the economy.

The income multiplier on the other hand arises from the fact that each industry besides using the other sectors output as input in their own production process, also uses labor as an input in production. There are two types of income multipliers: Type One Income Multiplier (M1) and Type Two Income Multiplier (M2). M1 takes into consideration the change in income (direct and indirect) resulting from a one Jordanian Dinar increase in the value of output of all industries in the processing sectors. It can be calculated by first finding a row representing the relationship between the income of the

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[37] For more information on the so-called input-output multipliers, see, for example, Moore and Petersen (1955), Hirsch (1959), Bradley (1967), and Bradley and Gander (1968).

labor to the total output of the corresponding sector. Then, multiplying this vector by the Leontief inverse matrix will give us the direct and indirect changes of income. Dividing the direct and indirect vector of income changes by the vector of direct income changes will provide us with the M1. That is, if we assume that:

R : a vector of direct income changes (l_j/X_j, where l_j is the wages and salaries paid by sector j);

S : a vector of direct and indirect income changes; i.e:

$S = R\ [I - A]^{-1}$

Then:

$$M1 = \frac{S}{R} \qquad (5.6)$$

In the case of M2, we need to make some modifications to the input-output table before doing the calculations. That is, the household sector is considered endogenous to the model. Thus we include the row and the column of the household sector in the original matrix of technical coefficients. Then we find the Leontief inverse matrix for the new technological coefficient matrix with household consumption endogenous to the system. The new Leontief inverse matrix includes not only direct and indirect income changes but also induced changes in the household sector. After that we divide the row of the household from the new Leontief inverse matrix (where

household sector is endogenous) by the row of direct income, i.e, labor input per unit of output. The result, then, will be M2. Thus, if we assume that:

H : a vector of direct, indirect, and induced income changes; i.e, the household row of the new Leontief inverse matrix (household endogenous);

R : a vector of direct income changes (l_j/X_j, where l_j is the wages and salaries paid by sector j); then

$$M2 = \frac{H}{R} \qquad (5.7)$$

The employment multiplier is used to show the impact of a change in the demand on employment levels across different sectors in the economy. In calculating this type of multiplier, the physical units of labor (i.e., in person-years) will be used. Thus to be in line with what has been done in the case of income multipliers, we would use the same methodology in finding both Type I and Type II employment multipliers. An exception to this case is that employment is given in terms of physical units rather than in terms of income payments to the household. So there will be two types of employment multipliers: Type I and Type II.

Type I employment multiplier takes into consideration the effect of change in final demand on the level of employment by

different sectors in the economy where the household sector is exogenous. Type I employment multiplier is given by the following equation:

$$\textit{Type I Employment Multiplier} = e_j * [I - A_g]^{-1} * e_d^{-1} \quad (5.8)$$

where

e_j : matrix of direct employment (in physical units)/ output ratios;

A_g : the aggregated input-output matrix (9 x 9);

$[I - A_g]^{-1}$: the Leontief inverse matrix of the aggregated sectors (9 x 9);

e_d : the diagonal matrix of the direct employment/ output ratio.

In the case of Type II employment multiplier, (as in Type II Income multiplier) not only are the direct and indirect employment effects are considered, but also the induced effect is added to both direct and indirect employment effects. Therefore, a modification to the matrix of the aggregated model will be applied. This modification will be represented by introducing the household sector into the system, i.e., making the household sector as endogenous to the system. Then, after finding the inverse of the matrix $[I - A_g]$ we premultiply this inverted matrix by the vector of direct employment-output to get the direct, indirect, and induced employment effect. Then by dividing the new output of this

multiplication by the direct employment effect for the corresponding sector, we get Type II employment multiplier for each sector (see equation 5.8 above). Also it is assumed that there is a linear relationship between employment and gross output of each sector in the economy.

5.3 Summary

In conclusion then, this model, the Leontief open static model, is used in the dissertation here to analyze the water supply system in Jordan and its allocation amongst the various sectors of the economy. A closer analysis of the water system using the Leontief open static model will enable us to investigate the direct and indirect demand for water amongst the different sectors of the Jordanian economy and the interrelationship of these sectors and their impact on water resources. The following chapter will make use of this model to apply it to the Jordanian economy.

CHAPTER 6

EMPIRICAL APPLICATIONS OF THE THEORETICAL MODEL FOR LONG-RUN PLANNING

Since its development in 1930s by Professor Wassily Leontief, the input-output approach has been widely used as a tool in analyzing regional and national economies. Its basic theme is that the economy of a certain region or country is divided into different sectors or industries.[38] Each sector's output could be used as an input by other sectors as well as the sector itself. So the input-output table for a particular country shows the flow of goods and services among its different sectors in a certain time period. The flow of goods and services could be represented either by physical units or in value terms.

This chapter will present a general description of the input-output tables of Jordan economy for the base year 1983. It also shows the empirical results. Two specific effects for the economy are considered. They are income and employment effects as a result of changes in the demand of each sector. Additionally, the input-output multipliers will be presented.

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[38] The term sector or industry will be used interchangeably through out the study.

These are output, income, and employment multipliers as developed in the preceding Chapter.

6.1 An Overview of Jordan's Input-Output Tables

There are three basic tables necessary in the analysis of our input-output model: The input-output flow (or interindustry transactions) table, Jordan 1983 (see Table 6.1); the input-output technical coefficients (or direct requirements) table (see Table 6.2); and the table of direct and indirect requirements per JD 1.0 of final demand (see Table 6.3).

6.1.1 The Input-Output Flow Table

Table 6.1 shows the input-output flow of goods and services for the Jordanian economy in value terms (thousands of JDs). The input-output table for Jordan has been divided into three groups: processing sectors, final demand sectors, and final payments sectors.

6.1.1.1 The Processing Sectors

The processing sectors, as shown in Table 6.1, are represented by the first thirty-five sectors. The numbers in the table show the transactions allocated to these different industries. For example, if we consider column 1 (Agriculture), it shows the amount of goods and services purchased from different sectors, including the Agriculture

Table 6.1: Input-Output Flow Table for Jordan, 1983 (in thousands Jordanian Dinars)

		INTERMEDIATE DEMAND								
	TO	AGRI-CULTURE	FERTILIZ. MINERAL MINING	OTHER MINING & CRUDE OIL	GRAIN MILL PRODUCTS	BAKERY PRODUCTS	CONFEC-TIONARY	OTHER FOOD MANUFACTURE	PREPARED ANIMAL FOOD	BEVER-AGES
FROM		1	2	3	4	5	6	7	8	9
AGRICULTURE	1	9596	0	0	12142	20577	1478	102655	7196	774
FERTILIZER MINERAL MINING	2	2148	0	0	0	0	0	0	0	0
OTHER MINING & CRUDE OIL	3	0	0	4731	6	271	0	6	0	0
GRAIN MILL PRODUCTS	4	0	0	0	295	6468	100	9	59	0
BAKERY PRODUCTS	5	0	0	0	1	81	0	3	0	0
CONFECTIONARY	6	0	0	0	0	25	312	23	0	283
OTHER FOOD MANUFACTURE	7	0	0	0	42	1922	1692	3402	3963	1302
PREPARED ANIMAL FOOD	8	15569	0	0	0	0	0	0	449	0
BEVERAGES	9	0	0	0	0	0	0	0	0	19
TOBACCO	10	0	0	0	0	0	0	0	0	0
TEXTILE MANUFACTURE	11	0	128	9	351	441	0	0	112	0
WEARING APPAREL	12	0	0	0	0	0	0	0	0	0
LEATHER & FOOTWEAR	13	0	0	0	0	0	0	0	0	0
WOOD, CORK & FURNITURE	14	0	0	0	0	0	0	14	0	220
PAPER & PAPER PRODUCTS	15	0	153	0	10	675	664	1332	122	334
PRINTING & PUBLISHING	16	0	102	2	7	38	12	18	3	16
IND. & OTHER CHEMICALS	17	7495	327	411	2	1779	41	299	186	1068
PETROLEUM REFINERY	18	1877	6205	645	157	1275	116	294	85	195
RUBBER & PLASTIC	19	376	0	0	38	842	10	937	14	268
POTTERY & GLASS	20	0	0	0	0	0	0	15	0	119
CEMENT, LIME & PLASTER	21	0	0	9	0	0	0	0	0	0
OTHER NONMETAL MIN. PRODS.	22	0	0	0	0	0	0	0	0	0
BASIC METAL INDUSTRIES	23	0	0	0	0	68	34	91	0	70
FABRICATED METAL PRODUCTS	24	0	0	0	0	0	2	546	0	768
MACHINERY (NONELECTRICAL)	25	0	3365	302	551	162	17	178	46	488
ELECT. & TRANSPORT EQUIP.	26	0	0	0	0	0	0	0	0	0
MISCELLANEOUS MANUFACTURING	27	0	0	0	0	37	0	0	0	0
ELECTRICITY	28	0	3477	66	124	487	65	331	12	190
WATER SUPPLY	29	3029	3	0	3	183	28	52	2	311
CONSTRUCTION	30	0	0	0	9	91	8	28	2	16
DISTRIBUTION	31	122992	14043	438	2283	3640	1509	27462	1306	3336
TRANSPORT & COMMUNICATION	32	1249	11625	63	18	104	4	18	80	163
FINANCE & BUSINESS SERVS.	33	157	2072	197	179	136	61	142	100	235
HEALTH & EDUCATION	34	0	0	0	0	0	0	0	0	0
OTHER SERVICES	35	634	10968	68	20	78	48	28	16	320
TOTAL INTERMEDIATE INPUTS	36	165122	52468	6941	16238	39380	6201	137883	13753	10495
WAGES & OTHER BENEFITS	37	25100	14344	1266	491	1485	420	1714	255	1735
OTHER VALUE ADDED	38	84900	14280	8076	2865	2144	775	1993	905	6259
TOTAL VALUE ADDED	39	110000	28624	9342	3356	3629	1195	3707	1160	7994
TOTAL DOMESTIC OUTPUT	40	275122	81092	16283	19594	43009	7396	141590	14913	18489
IMPORTS	41	101246	7364	208700	5072	1093	3693	72966	4411	2577
TOTAL SUPPLY	42	376368	88456	224983	24666	44102	11089	214556	19324	21066

Table 6.1 Continued

TOBACCO	TEXTILE MANUFACTUR	WEARING APPAREL	LEATHER & FOOTWEAR	WOOD, CORK & FURNITURE	PAPER & PRODUCTS	PRINTING & PUBLISHING	IND. & OTHER CHEMICALS	PETROLEUM REFINERY	RUBBER & PLASTIC	POTTERY & GLASS	CEMENT, LIME & PLASTER
10	11	12	13	14	15	16	17	18	19	20	21
8642	743	0	5	0	0	0	43	0	16	0	0
0	0	0	0	0	0	0	12734	0	1	6	0
0	0	0	0	0	0	0	34	192823	105	85	576
0	32	0	0	0	0	0	31	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	28	6	0	0	0
0	4	0	543	0	72	0	414	21	20	0	0
0	0	0	0	0	0	0	0	0	18	0	0
0	0	0	0	0	0	0	0	0	0	0	0
53	0	0	0	0	0	0	0	0	0	0	0
0	4134	5451	475	93	905	11	224	0	10	0	0
0	2	22	0	0	0	0	0	18	0	0	0
0	0	0	1875	2	0	0	0	0	66	0	0
0	0	0	10	6422	4	0	38	0	2	0	0
1701	9	91	54	3	9331	3134	4811	0	4	7	1035
7	6	25	18	9	24	3	124	73	15	2	68
31	1100	235	452	699	543	363	26103	797	4287	36	229
29	53	79	55	107	294	71	2121	12211	879	147	5727
0	2	8	83	68	92	131	94	0	900	0	0
0	0	0	0	15	0	0	533	0	0	6	0
0	0	0	0	0	0	0	3	0	0	69	0
0	0	0	0	0	0	0	0	0	0	2	0
0	1	5	0	177	1	15	482	0	389	73	451
0	1	0	4	502	1	0	0	0	0	5	0
262	188	88	73	96	483	88	916	714	283	0	0
0	0	0	0	0	0	0	0	0	5	1	0
0	0	140	68	0	0	0	3	0	78	0	0
92	134	188	70	166	237	65	361	179	413	17	1983
9	2	1	0	17	11	2	46	6	22	3	44
0	33	10	0	19	11	12	0	8	21	1	49
2468	2517	1907	2083	6608	3799	1646	13278	4322	2543	4527	4515
107	46	59	15	56	263	37	644	2585	127	5	125
239	306	66	72	86	512	158	1211	332	226	30	32
0	0	0	0	0	0	0	0	608	0	0	0
90	324	159	99	134	198	67	887	816	190	56	2170
13730	9637	8534	6054	15279	16781	5803	65163	215519	10620	5078	17004
2217	1343	2268	1156	2098	2140	2121	7756	9624	1617	2280	3465
27189	1752	1855	2681	4380	1982	1600	10109	16703	3799	7220	16335
29406	3095	4123	3837	6478	4122	3721	17865	26327	5416	9500	19800
43136	12732	12657	9891	21757	20903	9524	83028	241846	16036	14578	36804
2321	35064	22903	6315	35527	12023	4985	51608	6809	18405	9521	22820
45457	47796	35560	16206	57284	32926	14509	134636	248655	34441	24099	59624

Table 6.1 Continued

OTHER NON-METAL MIN. PRODS	BASIC METAL INDUSTRIES	FABRICATED METAL PRODUCTS	MACHINERY (NON-ELECT.)	ELECT. & TRANSPORT EQUIPMENT.	MISCEL. MANUF.	ELEC-TRICITY	WATER SUPPLY	CON-STRUCTION	DISTRI-BUTION	TRANSPORT & COMMUN.	FINANCE & BUSINESS SERVICES.
22	23	24	25	26	27	28	29	30	31	32	33
0	33	0	0	0	0	0	0	17	0	2893	0
31	0	0	0	4	29	0	0	0	0	0	0
6929	19587	2	0	208	0	0	0	3740	0	1	0
0	0	1	0	0	0	0	0	0	0	69	0
0	0	0	0	0	0	0	0	0	0	160	0
0	0	0	0	0	0	0	0	0	0	182	0
0	7	2	0	0	0	0	0	0	0	1083	0
0	5	2	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	4	41	0	0	0	0	0	0	255	1752	0
0	0	0	0	0	0	0	3	0	0	493	0
0	0	1	0	0	0	0	0	0	0	0	0
13	0	285	51	15	0	0	136	854	1239	561	0
0	5	33	6	31	10	0	0	0	1553	94	0
19	17	34	6	3	0	118	5	0	710	1026	1002
65	275	643	114	429	99	0	717	3057	134	3497	1464
844	642	382	36	58	5	29106	1027	245	2779	100376	761
17	0	14	2	14	15	509	4	1462	1403	14290	0
0	3	237	40	21	1	0	0	1984	0	0	0
6320	2	57	0	0	0	0	0	45171	0	635	0
86	1	1566	288	0	0	0	0	28989	0	2620	0
399	4690	7120	1190	681	1	0	0	69754	0	0	0
6	64	1869	333	10	0	0	0	15276	7430	122	0
0	1173	316	59	20	7	725	80	4336	188	242	0
0	0	531	97	38	0	0	325	2692	701	14476	1104
0	0	0	0	0	1	0	0	0	0	29	0
309	925	188	32	51	8	396	3058	210	217	1198	1588
243	18	4	1	2	0	134	3	182	124	269	176
36	0	2	0	4	0	85	1	0	965	2940	720
2143	5695	3055	15579	9438	1408	0	0	0	10134	0	0
66	49	219	39	11	4	541	267	19	12719	26265	12951
384	346	370	254	17	10	854	455	3684	13258	21309	1184
0	0	0	0	0	0	0	0	0	0	496	0
571	410	526	93	15	5	3550	0	10628	23	10522	3783
18481	33951	17500	18220	11070	1603	36018	6081	192300	53832	207600	24733
4920	1425	4007	4514	512	41	9169	4831	74300	55042	68500	25800
7752	4559	4644	9308	424	73	7008	3392	52500	168878	87900	48800
12672	5984	8651	13822	936	114	16177	8223	126800	223920	156400	74600
31153	39935	26151	32042	12006	1717	52195	14304	319100	277752	364000	99333
10740	51789	79875	115233	161848	9224	0	0	0	0	78280	18772
41893	91724	106026	147275	173854	10941	52195	14304	319100	277752	442280	118105

Table 6.1 Continued

			FINAL DEMAND							
HEALTH & EDUCATION	OTHER SERVICES	TOTAL INTERMED. INPUTS	HOUSEHOLD CONSUMPTION	GOVNT. CONSUMPTION	FIXED CAPITAL FORMATION	NET CHANGE IN STOCKS	TOURIST CONSUMPTION	EXPORTS	TOTAL FINAL DEMAND	TOTAL DEMAND
34	35	36	37	38	39	40	41	42	43	44
1923	232	168965	156062	6424	0	3500	8208	33209	207403	376368
0	0	14953	336	0	0	0	0	73167	73503	88456
0	0	229104	227	74	0	-4705	0	283	-4121	224983
110	0	7174	14775	1010	0	0	1450	257	17492	24666
219	0	464	40997	243	0	0	2135	263	43638	44102
225	0	1084	7956	188	0	0	1452	409	10005	11089
2012	0	16501	181157	2018	0	-40	11007	3913	198055	214556
55	0	16098	225	0	0	2900	0	101	3226	19324
0	0	19	19241	600	0	-362	1263	305	21047	21066
0	0	53	40268	0	0	27	1581	3528	45404	45457
0	489	14885	28755	1698	0	194	111	2153	32911	47796
141	56	735	30644	1960	0	-512	239	2494	34825	35560
0	0	1944	13232	704	0	-26	41	311	14262	16206
29	885	10778	41667	54	432	236	202	3915	46506	57284
2127	63	27392	2230	1264	0	-562	804	1798	5534	32926
227	274	4013	8263	496	0	0	1577	160	10496	14509
5491	1248	63716	54374	1132	0	-400	938	14876	70920	134636
708	6701	176292	46999	4471	0	2000	18839	54	72363	248655
48	308	21949	2534	648	2749	105	698	5758	12492	34441
0	8689	11663	11493	40	0	0	21	882	12436	24099
1174	636	54076	2824	571	0	2000	0	153	5548	59624
0	0	33552	0	135	0	2600	0	5606	8341	41893
0	2002	87694	0	255	1064	1802	0	909	4030	91724
0	753	27692	25255	1176	48677	0	190	3036	78334	106026
0	0	15446	31880	14430	83849	650	47	973	131829	147275
37	1276	21283	66473	16542	64129	74	4133	1220	152571	173854
0	0	356	8563	411	0	0	1345	266	10585	10941
1011	4294	22142	26511	2433	0	0	1109	0	30053	52195
756	2423	8109	4108	1740	0	0	347	0	6195	14304
480	59	5610	6940	1650	304900	0	0	0	313490	319100
0	0	274674	0	0	0	-4200	0	7278	3078	277752
6731	9586	86860	152046	37213	0	0	53752	112409	355420	442280
5324	718	54716	9416	3206	0	0	8564	42203	63389	118105
0	342	1446	201558	190	0	0	4690	0	206438	207884
3031	586	51113	45871	1553	0	0	58307	94680	200411	251524
31859	41620	1532551	1282880	104529	505800	5281	183050	416569	2498109	4030660
74356	36288	448600	3800	152000	0	0	0	0	155800	604400
8359	133760	755159	61000	2141	0	0	0	0	63141	818300
82715	170048	1203759	64800	154141	0	0	0	0	218941	1422700
114574	211668	2736310	1347680	758670	505800	5281	183050	416569	2717050	5453360
93310	39856	1294350	0	89630	0	0	0	0	89630	1383980
207884	251524	4030660	1347680	348300	505800	5281	183050	416569	2806680	6837340

Source: Jordan, Ministry of Planning, 1983.

Table 6.2: Input-Output Technical Coefficient Table, Jordan, 1983[a]

		INTERMEDIATE DEMAND									
	TO	AGRI-CULTURE	FERTILIZ. MINERAL MINING	OTHER MINING & CRUDE OIL	GRAIN MILL PRODUCTS	BAKERY PRODUCTS	CONFEC-TIONARY	OTHER FOOD MANUFACTURE	PREPARED ANIMAL FOOD	BEVER-AGES	TOBACCO
FROM		1	2	3	4	5	6	7	8	9	10
AGRICULTURE	1	0.0254963	0	0	0.4922565	0.4665775	0.1332852	0.4784532	0.3723867	0.0367417	0.1901137
FERTILIZER MINERAL MINING	2	0.0057072	0	0	0	0	0	0	0	0	0
OTHER MINING & CRUDE OIL	3	0	0	0.0210283	0.0002432	0.0061448	0	0.0000280	0	0	0
GRAIN MILL PRODUCTS	4	0	0	0	0.0119598	0.1466600	0.0090179	0.0000419	0.0030532	0	0
BAKERY PRODUCTS	5	0	0	0	0.0000405	0.0018367	0	0.0000140	0	0	0
CONFECTIONARY	6	0	0	0	0	0.0005669	0.0281360	0.0001072	0	0.0134340	0
OTHER FOOD MANUFACTURE	7	0	0	0	0.0017027	0.0435808	0.1525836	0.0158560	0.2050818	0.0618058	0
PREPARED ANIMAL FOOD	8	0.0413664	0	0	0	0	0	0	0.0232354	0	0
BEVERAGES	9	0	0	0	0	0	0	0	0	0.0009019	0
TOBACCO	10	0	0	0	0	0	0	0	0	0	0.0011659
TEXTILE MANUFACTURE	11	0	0.0014470	0.0000400	0.0142301	0.0099995	0	0	0.0057959	0	0
WEARING APPAREL	12	0	0	0	0	0	0	0	0	0	0
LEATHER & FOOTWEAR	13	0	0	0	0	0	0	0	0	0	0
WOOD, CORK & FURNITURE	14	0	0	0	0	0	0	0.0000653	0	0.0104434	0
PAPER & PAPER PRODUCTS	15	0	0.0017297	0	0.0004054	0.0153054	0.0598792	0.0062082	0.0063134	0.0158549	0.0374200
PRINTING & PUBLISHING	16	0	0.0011531	0.0000089	0.0002838	0.0008616	0.0010822	0.0000839	0.0001552	0.0007595	0.0001540
IND. & OTHER CHEMICALS	17	0.0199140	0.0036968	0.0018268	0.0000811	0.0403383	0.0036974	0.0013936	0.0096253	0.0506978	0.0006820
PETROLEUM REFINERY	18	0.0049871	0.0701479	0.0028669	0.0063650	0.0289103	0.0104608	0.0013703	0.0043987	0.0092566	0.0006380
RUBBER & PLASTIC	19	0.0009990	0	0	0.0015406	0.0190921	0.0009018	0.0043672	0.0007245	0.0127219	0
POTTERY & GLASS	20	0	0	0	0	0	0	0.0000699	0	0.0056489	0
CEMENT, LIME & PLASTER	21	0	0	0.0000400	0	0	0	0	0	0	0
OTHER NONMETAL MIN. PRODS.	22	0	0	0	0	0	0	0	0	0	0
BASIC METAL INDUSTRIES	23	0	0	0	0	0.0015419	0.0030661	0.0004241	0	0.0033229	0
FABRICATED METAL PRODUCTS	24	0	0	0	0	0	0.0001804	0.0025448	0	0.0364568	0
MACHINERY (NONELECTRICAL)	25	0	0.0380415	0.0013423	0.0223384	0.0036733	0.0015331	0.0008296	0.0023805	0.0231653	0.0057637
ELECT. & TRANSPORT EQUIP.	26	0	0	0	0	0	0	0	0	0	0
MISCELLANEOUS MANUFACTURING	27	0	0	0	0	0.0008390	0	0	0	0	0
ELECTRICITY	28	0	0.0393077	0.0002934	0.0050272	0.0110426	0.0058617	0.0015427	0.0006210	0.0090193	0.0020239
WATER SUPPLY	29	0.0080480	0.0000339	0	0.0001216	0.0041495	0.0025250	0.0002424	0.0001035	0.0147631	0.0001980
CONSTRUCTION	30	0.0000000	0	0	0.0003649	0.0020634	0.0007214	0.0001305	0.0001035	0.0007595	0
DISTRIBUTION	31	0.3267865	0.1587569	0.0019468	0.0925566	0.0825359	0.1360808	0.1279946	0.0675844	0.1583594	0.0542931
TRANSPORT & COMMUNICATION	32	0.0033186	0.1314213	0.0002800	0.0007297	0.0023582	0.0003607	0.0000839	0.0041399	0.0077376	0.0023539
FINANCE & BUSINESS SERVS.	33	0.0004171	0.0234241	0.0008756	0.0072570	0.0030838	0.0055009	0.0006618	0.0051749	0.0111554	0.0052577
HEALTH & EDUCATION	34	0	0	0	0	0	0	0	0	0	0
OTHER SERVICES	35	0.0016845	0.1239939	0.0003022	0.0008108	0.0017686	0.0043286	0.0001305	0.0008280	0.0151904	0.0019799

Table 6.2 Continued

TEXTILE MANUFACTUR	WEARING APPAREL	LEATHER & FOOTWEAR	WOOD, CORK & FURNITURE	PAPER & PRODUCTS	PRINTING & PUBLISHING	IND. & OTHER CHEMICALS	PETROLEUM REFINERY	RUBBER & PLASTIC	POTTERY & GLASS	CEMENT, LIME & PLASTER	OTHER NON-METAL MIN. PRODS	BASIC METAL INDUSTRIES	
11	12	13	14	15	16	17	18	19	20	21	22	23	
0.0155452	0	0.0003085	0	0	0	0.0003194	0	0.0004646	0	0	0	0.0003598	1
0	0	0	0	0	0	0.0945809	0	0.0000290	0.0002490	0	0.0007400	0	2
0	0	0	0	0	0	0.0002525	0.7754640	0.0030487	0.0035271	0.0096605	0.1653976	0.2135428	3
0.0006695	0	0	0	0	0	0.0002303	0	0	0	0	0	0	4
0	0	0	0	0	0	0	0	0	0	0	0	0	5
0	0	0	0	0	0	0.0002080	0.0000241	0	0	0	0	0	6
0.0000837	0	0.0335061	0	0.0021867	0	0.0030750	0.0000845	0.0005807	0	0	0	0.0000763	7
0	0	0	0	0	0	0	0	0.0005226	0	0	0	0.0000545	8
0	0	0	0	0	0	0	0	0	0	0	0	0	9
0	0	0	0	0	0	0	0	0	0	0	0	0	10
0.0864926	0.1532902	0.0293101	0.0016235	0.0274859	0.0007582	0.0016637	0	0.0002904	0	0	0	0.0000436	11
0.0000418	0.0006187	0	0	0	0	0	0.0000724	0	0	0	0	0	12
0	0	0.1156979	0.0000349	0	0	0	0	0.0019163	0	0	0	0	13
0	0	0.0006171	0.1121081	0.0001215	0	0.0002822	0	0.0000581	0	0	0.0003103	0	14
0.0001883	0.0025591	0.0033321	0.0000524	0.2833931	0.2160039	0.0357334	0	0.0001161	0.0002905	0.0173588	0	0.0000545	15
0.0001255	0.0007030	0.0011107	0.0001571	0.0007289	0.0002068	0.0009210	0.0002936	0.0004355	0.0000830	0.0011405	0.0004535	0.0001853	16
0.0230145	0.0066085	0.0278909	0.0122024	0.0164915	0.0250190	0.1938783	0.0032052	0.1244737	0.0014938	0.0038407	0.0015516	0.0029981	17
0.0011089	0.0022216	0.0033938	0.0018679	0.0089291	0.0048935	0.0157536	0.0491082	0.0255219	0.0060998	0.0960519	0.0201466	0.0069993	18
0.0000418	0.0002250	0.0051216	0.0011871	0.0027941	0.0090289	0.0006982	0	0.0261316	0	0	0.0004058	0	19
0	0	0	0.0002619	0	0	0.0039588	0	0	0.0002490	0	0	0.0000327	20
0	0	0	0	0	0	0.0000223	0	0	0.0028632	0	0.1508605	0.0000218	21
0	0	0	0	0	0	0	0	0	0.0000830	0	0.0020528	0.0000109	22
0.0000209	0.0001406	0	0.0030899	0.0000304	0.0010338	0.0035800	0	0.0112947	0.0030292	0.0075641	0.0095243	0.0511317	23
0.0000209	0	0.0002468	0.0087634	0.0000304	0	0	0	0	0.0002075	0	0.0001432	0.0006977	24
0.0039334	0.0024747	0.0045045	0.0016759	0.0146693	0.0060652	0.0068035	0.0028714	0.0082170	0	0	0	0.0127884	25
0	0	0	0	0	0	0	0	0.0001452	0.0000415	0	0	0	26
0	0.0039370	0.0041960	0	0	0	0.0000223	0	0.0022647	0	0	0	0	27
0.0028036	0.0052868	0.0043194	0.0028978	0.0071980	0.0044800	0.0026813	0.0007199	0.0119915	0.0007054	0.0332584	0.0073759	0.0100846	28
0.0000418	0.0000281	0	0.0002968	0.0003341	0.0001378	0.0003417	0.0000241	0.0006388	0.0001245	0.0007380	0.0058005	0.0001962	29
0.0006904	0.0002812	0	0.0003317	0.0003341	0.0008271	0	0.0000322	0.0006097	0.0000415	0.0008218	0.0008593	0	30
0.0526613	0.0536277	0.1285326	0.1153551	0.1153799	0.1134468	0.0986215	0.0173815	0.0738364	0.1878501	0.0757245	0.0511541	0.0620884	31
0.0009624	0.0016592	0.0009256	0.0009776	0.0079876	0.0025501	0.0047833	0.0103959	0.0036875	0.0002075	0.0020965	0.0015754	0.0005342	32
0.0064022	0.0018560	0.0044428	0.0015013	0.0155500	0.0108898	0.0089946	0.0013352	0.0065619	0.0012449	0.0005367	0.0091662	0.0037722	33
0	0	0	0	0	0	0	0.0024452	0	0	0	0	0	34
0.0067788	0.0044713	0.0061088	0.0023392	0.0060135	0.0046178	0.0065881	0.0032817	0.0055167	0.0023237	0.0363947	0.0136300	0.0044699	35

Table 6.2 Continued

FABRICATED METAL PRODUCTS	MACHINERY (NON-ELECT.)	ELECT. & TRANSPORT EQUIPMENT.	MISCEL. MANUF.	ELEC-TRICITY	WATER SUPPLY	CON-STRUCTION	DISTRI-BUTION	TRANSPORT & COMMUN.	FINANCE & BUSINESS SERVICES.	HEALTH & EDUCATION	OTHER SERVICES	
24	25	26	27	28	29	30	31	32	33	34	35	
0	0	0	0	0	0	0.0000533	0	0.0065411	0	0.0092504	0.0009224	1
0	0	0.0000230	0.0026506	0	0	0	0	0	0	0	0	2
0.0000189	0	0.0011964	0	0	0	0.0117205	0	0.0000023	0	0	0	3
0.0000094	0	0	0	0	0	0	0	0.0001560	0	0.0005291	0	4
0	0	0	0	0	0	0	0	0.0003618	0	0.0010535	0	5
0	0	0	0	0	0	0	0	0.0004115	0	0.0010823	0	6
0.0000189	0	0	0	0	0	0	0	0.0024487	0	0.0096785	0	7
0.0000189	0	0	0	0	0	0	0	0	0	0.0002646	0	8
0	0	0	0	0	0	0	0	0	0	0	0	9
0	0	0	0	0	0	0	0	0	0	0	0	10
0.0003867	0	0	0	0	0	0	0.0009181	0.0039613	0	0	0.0019441	11
0	0	0	0	0	0.0002097	0	0	0.0011147	0	0.0006783	0.0002226	12
0.0000094	0	0	0	0	0	0	0	0	0	0	0	13
0.0026880	0.0003463	0.0000863	0	0	0.0095078	0.0026763	0.0044608	0.0012684	0	0.0001395	0.0035186	14
0.0003112	0.0000407	0.0001783	0.0009140	0	0	0	0.0055913	0.0002125	0	0.0102317	0.0002505	15
0.0003207	0.0000407	0.0000173	0	0.0022608	0.0003496	0	0.0025562	0.0023198	0.0084840	0.0010920	0.0010894	16
0.0060646	0.0007741	0.0024676	0.0090485	0	0.0501258	0.0095801	0.0004824	0.0079068	0.0123957	0.0264138	0.0049618	17
0.0036029	0.0002444	0.0003336	0.0004570	0.5576396	0.0717981	0.0007678	0.0100053	0.2269513	0.0064434	0.0034057	0.0266416	18
0.0001320	0.0000136	0.0000805	0.0013710	0.0097519	0.0002796	0.0045816	0.0050513	0.0323098	0	0.0002309	0.0012245	19
0.0022353	0.0002716	0.0001208	0.0000914	0	0	0.0062175	0	0	0	0	0.0345454	20
0.0005376	0	0	0	0	0	0.1415575	0	0.0014357	0	0.0056474	0.0025286	21
0.0147700	0.0019555	0	0	0	0	0.0908461	0	0.0059238	0	0	0	22
0.0671533	0.0080801	0.0039171	0.0000914	0	0	0.2185961	0	0	0	0	0.0079595	23
0.0176278	0.0022611	0.0000575	0	0	0	0.0478721	0.0267505	0.0002758	0	0	0.0029938	24
0.0029804	0.0004006	0.0001150	0.0006398	0.0138902	0.0055928	0.0135882	0.0006769	0.0005472	0	0	0	25
0.0050082	0.0006586	0.0002186	0	0	0.0227209	0.0084362	0.0025238	0.0327304	0.0093476	0.0001780	0.0050731	26
0	0	0	0.0000914	0	0	0	0	0.0000656	0	0	0	27
0.0017731	0.0002173	0.0002933	0.0007312	0.0075869	0.2137864	0.0006581	0.0007813	0.0027087	0.0134457	0.0048633	0.0170719	28
0.0000377	0.0000068	0.0000115	0	0.0025673	0.0002097	0.0005704	0.0004464	0.0006082	0.0014902	0.0036366	0.0096333	29
0.0000189	0	0.0000230	0	0.0016285	0.0000699	0	0.0034743	0.0066474	0.0060963	0.0023090	0.0002346	30
0.0288137	0.1057817	0.0542869	0.1286902	0	0	0	0.0364858	0	0	0	0	31
0.0020655	0.0002648	0.0000633	0.0003656	0.0103650	0.0186661	0.0000595	0.0457926	0.0593855	0.1096567	0.0323786	0.0381117	32
0.0034897	0.0017247	0.0000978	0.0009140	0.0163617	0.0318093	0.0115450	0.0477332	0.0481799	0.0100250	0.0256104	0.0028546	33
0	0	0	0	0	0	0	0	0.0011215	0	0	0.0013597	34
0.0049610	0.0006315	0.0000863	0.0004570	0.0680142	0	0.0333062	0.0000828	0.0237904	0.0320308	0.0145802	0.0023298	35

Note: [a] Calculations in this table are based on (Table 6.1).

Table 6.3: Direct and Indirect Requirements Per Jordanian Dinar of Final Demand, Jordan, 1983[a]

	TO	INTERMEDIATE DEMAND										
		AGRI-CULTURE	FERTILIZ. MINERAL MINING	OTHER MINING & CRUDE OIL	GRAIN MILL PRODUCTS	BAKERY PRODUCTS	CONFEC-TIONARY	OTHER FOOD MANUFACTURE	PREPARED ANIMAL FOOD	BEVER-AGES	TOBACCO	
FROM		1	2	3	4	5	6	7	8	9	10	
AGRICULTURE	1	1.0480466	0.0016013	0.0000126	0.5233980	0.5896492	0.2288851	0.5096794	0.5084555	0.0735857	0.1996420	1
FERTILIZER MINERAL MINING	2	0.0087158	1.0009845	0.0002253	0.0044963	0.0101702	0.0027062	0.0045510	0.0055533	0.0071285	0.0018954	2
OTHER MINING & CRUDE OIL	3	0.0163498	0.1157717	1.0243187	0.0192139	0.0536974	0.0231229	0.0135331	0.0165782	0.0277280	0.0076341	3
GRAIN MILL PRODUCTS	4	0.0001509	0.0000400	0.0000008	1.0121990	0.1488272	0.0094386	0.0001226	0.0032573	0.0001627	0.0000322	4
BAKERY PRODUCTS	5	0.0000097	0.0000592	0.0000003	0.0000488	1.0018568	0.0000095	0.0000219	0.0000121	0.0000104	0.0000046	5
CONFECTIONARY	6	0.0000189	0.0000749	0.0000009	0.0000136	0.0006184	1.0289803	0.0001256	0.0000410	0.0138697	0.0000075	6
OTHER FOOD MANUFACTURE	7	0.0094262	0.0004988	0.0000102	0.0064938	0.0503061	0.1618741	1.0207731	0.2180318	0.0660291	0.0019422	7
PREPARED ANIMAL FOOD	8	0.0443877	0.0000720	0.0000006	0.0221688	0.0249850	0.0096961	0.0215895	1.0453242	0.0031262	0.0084559	8
BEVERAGES	9	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	1.0009027	0.0000000	9
TOBACCO	10	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	1.0011673	10
TEXTILE MANUFACTURE	11	0.0010169	0.0029784	0.0000609	0.0164748	0.0149564	0.0033517	0.0009944	0.0076128	0.0014959	0.0019029	11
WEARING APPAREL	12	0.0000338	0.0002210	0.0000011	0.0000276	0.0000390	0.0000258	0.0000262	0.0000310	0.0000391	0.0000161	12
LEATHER & FOOTWEAR	13	0.0000089	0.0000152	0.0000001	0.0000099	0.0000515	0.0000095	0.0000166	0.0000103	0.0000353	0.0000034	13
WOOD, CORK & FURNITURE	14	0.0020404	0.0017135	0.0000177	0.0015751	0.0018913	0.0014849	0.0018041	0.0015823	0.0133576	0.0007555	14
PAPER & PAPER PRODUCTS	15	0.0052016	0.0052679	0.0001514	0.0042872	0.0290644	0.0909357	0.0127612	0.0151160	0.0298001	0.0540487	15
PRINTING & PUBLISHING	16	0.0012509	0.0026517	0.0000319	0.0013295	0.0022033	0.0021573	0.0011577	0.0012166	0.0018244	0.0007118	16
IND. & OTHER CHEMICALS	17	0.0289043	0.0102851	0.0023812	0.0159505	0.0719089	0.0147954	0.0173553	0.0280272	0.0708967	0.0079908	17
PETROLEUM REFINERY	18	0.0201196	0.1450733	0.0035695	0.0234219	0.0584046	0.0277518	0.0163845	0.0204232	0.0324075	0.0094133	18
RUBBER & PLASTIC	19	0.0040247	0.0069419	0.0000426	0.0044818	0.0236773	0.0043182	0.0075629	0.0046840	0.0158372	0.0015434	19
POTTERY & GLASS	20	0.0003182	0.0046913	0.0000256	0.0002561	0.0006144	0.0003770	0.0002929	0.0003119	0.0067557	0.0001863	20
CEMENT, LIME & PLASTER	21	0.0003527	0.0010837	0.0000478	0.0003517	0.0006882	0.0003987	0.0003249	0.0003188	0.0005645	0.0001560	21
OTHER NONMETAL MIN. PRODS.	22	0.0004537	0.0013045	0.0000099	0.0004401	0.0006512	0.0004167	0.0004326	0.0004075	0.0010280	0.0002035	22
BASIC METAL INDUSTRIES	23	0.0013242	0.0025200	0.0000366	0.0013278	0.0038910	0.0046487	0.0018307	0.0012778	0.0080556	0.0005724	23
FABRICATED METAL PRODUCTS	24	0.0101348	0.0054976	0.0000775	0.0079554	0.0093016	0.0078874	0.0113679	0.0083902	0.0437226	0.0037324	24
MACHINERY (NONELECTRICAL)	25	0.0012755	0.0398092	0.0014217	0.0236213	0.0095637	0.0041106	0.0019024	0.0038626	0.0254934	0.0069618	25
ELECT. & TRANSPORT EQUIP.	26	0.0022681	0.0069053	0.0000430	0.0018172	0.0022809	0.0016830	0.0018441	0.0018985	0.0023681	0.0009710	26
MISCELLANEOUS MANUFACTURING	27	0.0000117	0.0000275	0.0000002	0.0000121	0.0008980	0.0000115	0.0000191	0.0000130	0.0000395	0.0000046	27
ELECTRICITY	28	0.0032425	0.0438800	0.0003541	0.0072553	0.0161066	0.0090940	0.0036980	0.0031997	0.0148110	0.0034184	28
WATER SUPPLY	29	0.0087302	0.0017143	0.0000097	0.0045945	0.0093179	0.0047886	0.0045969	0.0045036	0.0158706	0.0019671	29
CONSTRUCTION	30	0.0015964	0.0020667	0.0000214	0.0016767	0.0036661	0.0019899	0.0015034	0.0014390	0.0019426	0.0006628	30
DISTRIBUTION	31	0.3667841	0.1774849	0.0026240	0.2852351	0.3274668	0.2616027	0.3162562	0.2831346	0.2223649	0.1341944	31
TRANSPORT & COMMUNICATION	32	0.0262582	0.1611546	0.0006703	0.0207828	0.0271220	0.0186476	0.0208487	0.0243745	0.0258449	0.0125139	32
FINANCE & BUSINESS SERVS.	33	0.0207036	0.0419849	0.0011114	0.0234275	0.0242039	0.0217348	0.0181402	0.0217236	0.0260188	0.0137139	33
HEALTH & EDUCATION	34	0.0000853	0.0007170	0.0000101	0.0000868	0.0001842	0.0000996	0.0000680	0.0000834	0.0001355	0.0000426	34
OTHER SERVICES	35	0.0048984	0.1335062	0.0004478	0.0045487	0.0080726	0.0079645	0.0033799	0.0045207	0.0200889	0.0040454	35

Table 6.3 Continued

TEXTILE MANUFACTUR	WEARING APPAREL	LEATHER & FOOTWEAR	WOOD, CORK & FURNITURE	PAPER & PRODUCTS	PRINTING & PUBLISHING	IND. & OTHER CHEMICALS	PETROLEUM REFINERY	RUBBER & PLASTIC	POTTERY & GLASS	CEMENT, LIME & PLASTER	OTHER NON-METAL MIN. PRODS	BASIC METAL INDUSTRIES	
11	12	13	14	15	16	17	18	19	20	21	22	23	
0.0184057	0.0029081	0.0205142	0.0001727	0.0025781	0.0007725	0.0030681	0.0002340	0.0016272	0.0001210	0.0002115	0.0001300	0.0005410	1
0.0031686	0.0013308	0.0041984	0.0017204	0.0030602	0.0038297	0.1177367	0.0006260	0.0151992	0.0005151	0.0006679	0.0011826	0.0004811	2
0.0060183	0.0075968	0.0119451	0.0085142	0.0240761	0.0169490	0.0391909	0.8388450	0.0422457	0.0147369	0.1127939	0.2133211	0.2440263	3
0.0007536	0.0001192	0.0000425	0.0000081	0.0000426	0.0000206	0.0003042	0.0000068	0.0000438	0.0000035	0.0000051	0.0000034	0.0000029	4
0.0000027	0.0000026	0.0000054	0.0000036	0.0000096	0.0000065	0.0000133	0.0000078	0.0000056	0.0000043	0.0000044	0.0000035	0.0000022	5
0.0000102	0.0000062	0.0000195	0.0000083	0.0000192	0.0000169	0.0002834	0.0000365	0.0000421	0.0000059	0.0000098	0.0000063	0.0000041	6
0.0003851	0.0001151	0.0388845	0.0000948	0.0033129	0.0008711	0.0042028	0.0001822	0.0013840	0.0000484	0.0001272	0.0000581	0.0001349	7
0.0007800	0.0001238	0.0008731	0.0000092	0.0001126	0.0000392	0.0001322	0.0000110	0.0006199	0.0000062	0.0000103	0.0000070	0.0000822	8
0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	9
0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	10
1.0949763	0.1682143	0.0369336	0.0023108	0.0424968	0.0103660	0.0047860	0.0001808	0.0012041	0.0003425	0.0010257	0.0003259	0.0002180	11
0.0000565	1.0006361	0.0000195	0.0000127	0.0000360	0.0000240	0.0000498	0.0000951	0.0000228	0.0000148	0.0000312	0.0000200	0.0000093	12
0.0000017	0.0000021	1.1308520	0.0000501	0.0000131	0.0000255	0.0000072	0.0000013	0.0002282	0.0000032	0.0000029	0.0000029	0.0000016	13
0.0004316	0.0004043	0.0017623	1.1270503	0.0012257	0.0009681	0.0014028	0.0001591	0.0007349	0.0010452	0.0006437	0.0008767	0.0004133	14
0.0026418	0.0051787	0.0097437	0.0023043	1.3991238	0.3051210	0.0643444	0.0006982	0.0093943	0.0023904	0.0257843	0.0047731	0.0010586	15
0.0004928	0.0010238	0.0019576	0.0006796	0.0019132	1.0011902	0.0021118	0.0004627	0.0011144	0.0007350	0.0016395	0.0010347	0.0005106	16
0.0323874	0.0137821	0.0430118	0.0181734	0.0321928	0.0404362	1.2446185	0.0066027	0.1602164	0.0028018	0.0070427	0.0046518	0.0050519	17
0.0073312	0.0093640	0.0146907	0.0092439	0.0298921	0.0205831	0.0473576	1.0588889	0.0454255	0.0128544	0.1274055	0.0503113	0.0176743	18
0.0007693	0.0009502	0.0076487	0.0024990	0.0060140	0.0117315	0.0032881	0.0006131	1.0282125	0.0014489	0.0013252	0.0012906	0.0007007	19
0.0004526	0.0003017	0.0005213	0.0005442	0.0005725	0.0005085	0.0058470	0.0001855	0.0010281	1.0003979	0.0014339	0.0007752	0.0002808	20
0.0002251	0.0001575	0.0002048	0.0002290	0.0003528	0.0003647	0.0003703	0.0001334	0.0002718	0.0030666	1.0003520	0.1514835	0.0001328	21
0.0001859	0.0001453	0.0002441	0.0003593	0.0004119	0.0003604	0.0004020	0.0001229	0.0002654	0.0003170	0.0002281	1.0022738	0.0001478	22
0.0006902	0.0006235	0.0009881	0.0050485	0.0012607	0.0023287	0.0056801	0.0002149	0.0135357	0.0038935	0.0088711	0.0119797	1.0543739	23
0.0020727	0.0019739	0.0052391	0.0139183	0.0051150	0.0046182	0.0045992	0.0006541	0.0029713	0.0056495	0.0025704	0.0021879	0.0027736	24
0.0048850	0.0035809	0.0062652	0.0024624	0.0215754	0.0114988	0.0145291	0.0043065	0.0109579	0.0003900	0.0016956	0.0010698	0.0141696	25
0.0005990	0.0005276	0.0011083	0.0008704	0.0017497	0.0013381	0.0020122	0.0005865	0.0011538	0.0010874	0.0009067	0.0008787	0.0005153	26
0.0000032	0.0039428	0.0047647	0.0000070	0.0000163	0.0000288	0.0000378	0.0000028	0.0023429	0.0000042	0.0000040	0.0000037	0.0000021	27
0.0038364	0.0063116	0.0062309	0.0039991	0.0116802	0.0080326	0.0099122	0.0013118	0.0144764	0.0014150	0.0351755	0.0148566	0.0112346	28
0.0003595	0.0001961	0.0004195	0.0004807	0.0008034	0.0005060	0.0008946	0.0001125	0.0009563	0.0002839	0.0012950	0.0062401	0.0003526	29
0.0011334	0.0007452	0.0008407	0.0009928	0.0015246	0.0018023	0.0010083	0.0002411	0.0012136	0.0008835	0.0013233	0.0014085	0.0003607	30
0.0715315	0.0697145	0.1743824	0.1392220	0.1792853	0.1633447	0.1614521	0.0224990	0.1038790	0.1971351	0.0867639	0.0692533	0.0716035	31
0.0071493	0.0069429	0.0130810	0.0097679	0.0261273	0.0177545	0.0358994	0.0139561	0.0150357	0.0116116	0.0111263	0.0090721	0.0058279	32
0.0114692	0.0071027	0.0153428	0.0093814	0.0330013	0.0254431	0.0251808	0.0041519	0.0150604	0.0115497	0.0068726	0.0141532	0.0083373	33
0.0000382	0.0000400	0.0000635	0.0000390	0.0001188	0.0000830	0.0001914	0.0026109	0.0001427	0.0000491	0.0003787	0.0001624	0.0000582	34
0.0090027	0.0068447	0.0095094	0.0040167	0.0120819	0.0093515	0.0259589	0.0044885	0.0108635	0.0034431	0.0402558	0.0214779	0.0061870	35

Table 6.3 Continued

FABRICATED METAL PRODUCTS	MACHINERY (NON-ELECT.)	ELECT. & TRANSPORT EQUIPMENT.	MISCEL. MANUF.	ELEC-TRICITY	WATER SUPPLY	CON-STRUCTION	DISTRI-BUTION	TRANSPORT & COMMUN.	FINANCE & BUSINESS SERVICES.	HEALTH & EDUCATION	OTHER SERVICES	
24	25	26	27	28	29	30	31	32	33	34	35	
0.0001413	0.0000719	0.0000416	0.0001137	0.0003670	0.0004646	0.0003243	0.0005555	0.0093711	0.0011391	0.0163785	0.0014352	1
0.0008216	0.0001471	0.0003403	0.0037972	0.0006368	0.0062075	0.0016126	0.0003968	0.0019230	0.0017821	0.0034475	0.0008285	2
0.0257430	0.0053538	0.0039726	0.0045571	0.4783220	0.1698815	0.1056823	0.0227120	0.2114432	0.0383689	0.0168421	0.0436308	3
0.0000135	0.0000020	0.0000016	0.0000050	0.0000084	0.0000233	0.0000064	0.0000150	0.0002427	0.0000316	0.0007237	0.0000144	4
0.0000021	0.0000025	0.0000012	0.0000032	0.0000105	0.0000123	0.0000029	0.0000211	0.0003918	0.0000444	0.0010705	0.0000174	5
0.0000045	0.0000033	0.0000022	0.0000065	0.0000286	0.0000337	0.0000076	0.0000263	0.0004688	0.0000571	0.0011409	0.0000233	6
0.0000780	0.0000276	0.0000228	0.0000716	0.0001694	0.0003309	0.0001160	0.0001984	0.0029863	0.0004016	0.0105155	0.0001782	7
0.0000300	0.0000041	0.0000023	0.0000062	0.0000220	0.0000219	0.0000309	0.0000283	0.0004168	0.0000508	0.0009657	0.0000634	8
0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	9
0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	10
0.0005824	0.0001886	0.0001108	0.0003071	0.0003771	0.0005194	0.0004065	0.0016403	0.0051106	0.0008051	0.0009695	0.0024614	11
0.0000084	0.0000082	0.0000040	0.0000106	0.0000889	0.0002661	0.0000209	0.0000677	0.0012270	0.0001482	0.0007306	0.0002794	12
0.0000123	0.0000019	0.0000011	0.0000054	0.0000242	0.0000085	0.0000124	0.0000167	0.0000781	0.0000096	0.0000043	0.0000067	13
0.0033313	0.0009860	0.0004002	0.0007254	0.0004625	0.0109610	0.0036297	0.0054536	0.0018055	0.0004126	0.0004349	0.0042297	14
0.0014290	0.0011472	0.0009320	0.0031067	0.0014022	0.0039074	0.0051846	0.0094105	0.0026408	0.0038291	0.0170465	0.0014174	15
0.0005477	0.0004182	0.0002069	0.0004674	0.0028389	0.0014578	0.0006570	0.0033041	0.0031860	0.0090536	0.0015846	0.0013716	16
0.0085517	0.0015329	0.0033510	0.0121111	0.0066969	0.0655915	0.0162856	0.0041479	0.0196833	0.0187531	0.0354546	0.0085756	17
0.0092035	0.0037865	0.0022541	0.0055246	0.6032668	0.2140382	0.0314251	0.0274102	0.2642448	0.0473526	0.0206931	0.0522684	18
0.0005961	0.0008391	0.0005072	0.0024508	0.0111601	0.0037404	0.0054243	0.0074560	0.0359984	0.0044258	0.0019561	0.0030057	19
0.0025441	0.0003379	0.0001547	0.0002106	0.0025561	0.0009317	0.0079227	0.0002491	0.0011682	0.0014204	0.0007929	0.0347977	20
0.0029047	0.0004065	0.0000558	0.0001285	0.0006010	0.0002917	0.1556817	0.0009047	0.0037932	0.0014894	0.0062379	0.0028668	21
0.0151497	0.0021250	0.0000692	0.0001639	0.0003764	0.0003095	0.0919095	0.0011681	0.0071015	0.0013798	0.0005129	0.0003737	22
0.0725342	0.0090754	0.0043362	0.0006070	0.0014674	0.0009575	0.2369433	0.0032496	0.0028899	0.0022281	0.0011024	0.0090912	23
1.0191469	0.0053863	0.0016461	0.0037685	0.0008314	0.0007082	0.0503020	0.0287156	0.0013097	0.0006971	0.0006623	0.0034899	24
0.0042342	1.0006913	0.0002950	0.0011034	0.0167168	0.0103262	0.0175131	0.0013495	0.0024764	0.0009643	0.0009818	0.0008725	25
0.0054917	0.0012737	1.0005173	0.0007466	0.0015148	0.0243334	0.0094815	0.0052494	0.0360235	0.0138156	0.0020410	0.0068651	26
0.0000020	0.0000024	0.0000015	1.0000979	0.0000275	0.0000131	0.0000133	0.0000211	0.0001580	0.0000191	0.0000117	0.0000110	27
0.0031741	0.0006433	0.0005021	0.0012988	1.0108212	0.2173991	0.0107732	0.0022955	0.0056005	0.0155976	0.0073032	0.0200468	28
0.0002512	0.0001036	0.0000533	0.0001084	0.0033871	1.0010814	0.0017816	0.0006550	0.0012208	0.0020336	0.0040803	0.0098195	29
0.0002583	0.0004845	0.0002663	0.0005904	0.0020440	0.0009620	1.0005452	0.0043601	0.0076187	0.0070879	0.0028515	0.0006563	30
0.0394599	0.1115614	0.0574660	0.1366955	0.0168447	0.0172452	0.0423072	1.0436539	0.0187281	0.0070881	0.0154576	0.0119890	31
0.0055798	0.0067707	0.0033635	0.0087983	0.0244324	0.0321950	0.0075403	0.0578647	1.0754007	0.1216741	0.0406885	0.0433958	32
0.0064534	0.0076080	0.0031384	0.0082842	0.0205798	0.0395748	0.0169523	0.0537483	0.0548242	1.0174485	0.0297408	0.0066703	33
0.0000376	0.0000186	0.0000099	0.0000257	0.0016013	0.0005853	0.0001447	0.0001374	0.0018928	0.0003033	1.0001211	0.0015439	34
0.0065072	0.0012806	0.0004309	0.0016935	0.0726425	0.0189773	0.0436630	0.0040168	0.0299281	0.0375757	0.0182858	1.0056531	35

Note: [a] Calculations in this table are based on (Table 6.1).

sector itself, and used by it as an input for the year 1983. As an example, column 1 (Agriculture) and row 18 (Petroleum Refinery), indicates that sector 1 purchases JD 1877 thousands worth of goods and services from the Petroleum Refinery sector as an input during the year 1983. Also, column 1 (Agriculture sector) and row 29 (Water Supply sector) indicate that sector 1 purchases JD 3029 thousands worth of water output as an input to agriculture production process during the year 1983.

6.1.1.2 Final Demand Sectors

As Table 6.1 shows, the final demand sector is formed from six sectors: Household Consumption, Government Consumption, Fixed Capital Formation, Net Change in Stocks, Tourist Consumption, and Exports.

The sectors of final demand represent the exogenous sector of the input-output table. The exogenous sector represents the final use of each of the processing sector's output by each of the final demand sector. The exogenous sector also shows the effect of the changes in its sectors demand on the level of output produced by the processing sectors in the economy. For example, in 1983 the total value of Sector 1's (Agriculture) output amounts to JD 376368 thousand, of which JD 207403 thousand are supplied to final demand sectors and JD 168965 thousand are supplied to intermediate sectors (see Table 6.1).

6.1.1.3 Final Payments Sectors

These sectors are given in Table 6.1 as Wages and Other Benefits, Other Value Added, and Imports. The payments to the household sector include wages and other benefits to the household by government. Imports represent purchasing of goods and services from outside the country by the different sectors. In the case of Sector 1 (Agriculture), the total value added amounts to JD 110000 thousand, of which JD 25100 thousand are payments to the household sector in the form of wages and other benefits by the agriculture sector. Also, the agriculture sector purchases JD 101246 thousand worth of imports as inputs to its production process (see Table 6.1).

6.1.1.4 Total Demand and Total Supply

The total demand (or gross output) and the total supply (or gross outlay) are shown, respectively in the last column and the last row of Table 6.1. For each of the processing sectors, the sum of the total demand and the total supply is equal. For example, adding across the row of sector 1 (agriculture) shows that its total output amounts to JD 376368 thousands. While adding down the column of the same sector, Sector 1 (agriculture) shows its total outlays amount to JD 376368 thousand too.

6.1.2 Input-Output Technical Coefficients Table

Table 6.2 shows the input-output technical coefficients or the direct requirements per Jordanian Dinar of output for the Jordanian economy in 1983. This table of direct requirements is derived from Table 6.1 (the basic interindustry transactions for the Jordanian economy, 1983). The direct requirements are calculated by dividing each column entry by its corresponding row totals. That is, dividing each input for the purchasing industry at the top from the selling industry at the left by the corresponding output of the industry at the top. For example, the value (0.0057072) in the second row and first column of Table 6.2 results from dividing JD 2148 thousand in row 2 and column 1 of Table 6.1 by the JD 376368 thousand--the total output of the industry in column 1 (agriculture). Therefore, the number (0.0057072) represents the direct inputs required by the agriculture sector from the sector of fertilizer mineral mining (sector 2). In other words, each entry in the table of input-output technical coefficients (or direct requirements), i.e., a_{ij}, represents the direct requirements of industry j from industry i per JD 1.0 of industry j's output.

6.1.3 The Direct and Indirect Requirements Table

Table 6.3 lists the total (direct and indirect) requirements that the purchasing industry in the column needs from the industry in the row per JD increase in the final

demand for the output of the corresponding industry in the column.[39] So unlike the table of technical coefficients (Table 6.2), which displays the direct sales from row sectors to the column sectors at the top, the table of direct and indirect requirements enables us to find out the total (both direct and indirect effects combined) effects associated with an increase in the final demand for the output of a particular industry. From this one can deduce the indirect effect. Therefore, it provides the necessary information that a decision maker would need to decide whether to spend money on this sector or another.

To explain what Table 6.3 shows, let us, as an example, look at Bakery Products sector (column 5). Reading down the column of Bakery Products (column 5) gives us the changes other sectors in the rows have to do to support a JD 1.0 increase in the final demand for the output of Bakery Products sector. So taking Water Supply sector (row 29) and Bakery Products sector (column 5) shows that the intersection of that row and the column is 0.0093179. This means that if the final demand for the output of the Bakery Products sector increases by JD 1.0, then the sales of the Water Supply sector output, directly and indirectly, have to increase by JD 0.0093179 to support that increase in the final demand of the Bakery Products (column 5). Of this, the direct demand of water by

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[39] The table of direct and indirect requirements is sometimes called a Leontief inverse matrix, i.e., $[I-A]^{-1}$.

the Bakery Products sector amounts to JD 0.0041495 which can be observed from row 29 and column 5 of Table 6.2. This leaves a derived demand (or indirect demand) of JD 0.0051684 from other sectors that support the Bakery Products sector.

6.2 Empirical Results

The input output table of 1983 for Jordan was used as a base for this study. This section will describe some of the findings of the study.

6.2.1 Input-Output Multipliers

In this study, three types of multipliers will be utilized. Output multipliers, income multipliers (Type I and Type II), and employment multipliers.[40]

6.2.1.1 Output Multipliers

One of the uses of the Leontief inverse matrix, i.e., $[I-A]^{-1}$, is that it enables us to determine the impact of a unit change in the final demand for the product of industry j on the output of all other industries in the economy. For example, if we assume that b_{ij} represents the elements of the $[I-A]^{-1}$, then the summation of b_{ij}'s over a column represents the output multiplier for the industry in the corresponding column. In other words,

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[40] For more information on the input-output multipliers, see O'Connor and Henry (1975), Bulmer-Thomas (1982), and Otto and Johnson (1993).

$$Output\ Multiplier(OM) = \sum_{i=1}^{n} b_{ij} \qquad (6.1)$$

where: (j=1,2,...,n)

Table 6.4 shows the output multipliers for different sectors in the Jordanian economy. These calculations are based on the Input-Output Table for Jordan for the base year 1983. Output multipliers are calculated for the 35 sectors which represent the Jordanian economy in the year 1983.

As Table 6.4 shows, sectors with higher output multipliers are Bakery Products (sector 5) with 2.53, Electricity (sector 28) with 2.28, Prepared Animal Food (sector 8) with 2.24, Other Food Manufacture (sector 7) with 2.01, and Petroleum Refinery (sector 18) with 1.96. Thus, if the final demand for the output of the agricultural sector increases by one Jordanian Dinar, this will generate JD 1.64 worth of output of **all** industries in the whole economy. While a JD 1.0 increase in the final demand for the output of the water supply sector will generate a JD 1.84 worth of output of all industries in the economy as a whole. This implies that when disaggregated, a JD 1.0 increase in the final demand for the product of Water Supply sector (sector 29) generates a significant level of output in itself (1.0011), and followed by Electricity (JD 0.2174) (sector 28), Petroleum Refinery (JD 0.2140) (sector 18), and Other Mining and Crude Oil (JD 0.1699) (sector 3), and other sectors of the economy.

Table 6.4: Output Multiplier (OM) for Different Sectors, Jordan 1983

Sector Number	Sector Name	Output Multiplier (OM)
1	AGRICULTURE	1.6381445
2	FERTILIZER MINERAL MINING	1.9185981
3	OTHER MINING & CRUDE OIL	1.0377368
4	GRAIN MILL PRODUCTS	2.0389796
5	BAKERY PRODUCTS	2.5263360
6	CONFECTIONERY	1.9549987
7	OTHER FOOD MANUFACTURE	2.0149653
8	PREPARED ANIMAL FOOD	2.2354161
9	BEVERAGES	1.7733415
10	TOBACCO	1.4805135
11	TEXTILE MANUFACTURE	1.2822463
12	WEARING APPAREL	1.3209089
13	LEATHER & FOOTWEAR	1.5623080
14	WOOD, CORK & FURNITURE	1.3641938
15	PAPER & PAPER PRODUCTS	1.8417960
16	PRINTING & PUBLISHING	1.6603152
17	IND. & OTHER CHEMICALS	1.8268730
18	PETROLEUM REFINERY	1.9632299
19	RUBBER & PLASTIC	1.5038755
20	POTTERY & GLASS	1.2782545
21	CEMENT, LIME & PLASTER	1.4779839
22	OTHER NON-METAL MIN. PRODS	1.5852753
23	BASIC METAL INDUSTRIES	1.4472705
24	FABRICATED METAL PRODUCTS	1.2348254
25	MACHINERY (NON-ELECTRICAL)	1.1622903
26	ELECT. & TRANSPORT EQUIP.	1.0844582
27	MISCELLANEOUS MANUFACTURING	1.1975910
28	ELECTRICITY	2.2823269
29	WATER SUPPLY	1.8433575
30	CONSTRUCTION	1.8643040
31	DISTRIBUTION	1.2904992
32	TRANSPORT & COMMUNICATION	1.8113526
33	FINANCE & BUSINESS SERVS.	1.3574877
34	HEALTH & EDUCATION	1.2608303
35	OTHER SERVICES	1.2779495

A further look at Table 6.4 shows that the highest output multiplier is that of the Bakery Products with a value of 2.53. This means that an increase of JD 1.0 in the demand for the output of Bakery Products will generate a total output of JD 2.53 in all industries, of which the most significant increases in output result from Bakery Products sector JD 1.002; Agricultural sector JD 0.589; Grain Mill Products sector JD 0.149; and Distribution sector JD 0.327.

For practical purposes, specifically for policy making, the output multiplier can aid the Jordanian government in their plans in the case of considering spending additional money on different sectors of the economy. For instance, if the government decides to spend additional money on any of these sectors, then the output multipliers may be a guiding device in determining the allocation of these funds in sectors with high output multipliers (see Table 6.4). This is so since the output multiplier for sector j, for example, means that for a JD 1.0 increase in the final demand for sector j's output will correspondingly stimulate output in the processing sectors of the economy.

6.2.1.2 Income Multipliers

As mentioned earlier, another use of the Leontief inverse matrix, $[I-A]^{-1}$, is to trace down the income effects. Here the focus is on changes in household income resulting from a change in the final demand sector. Two types of income

multipliers will be examined in this study: Type I and Type II.

Type I income multiplier (M1) is calculated by taking the total of direct and indirect payments to the household sector by the processing sectors and by dividing this figure by the direct payments of wages and salaries to the household sector.

Type II income multiplier (M2) displays the induced income effects that result from changes in the household income which in turn is a result of changes in the final demand. That is, this multiplier takes into consideration the repercussion effects of changes in household income as well. When the households income changes, their demand is affected which will consequently affect their consumption spending. Therefore, to calculate M2, the household sector is treated as endogenous to the model. In other words, it becomes just another sector in the economy; its output is its labor services that it sells to the other sectors, and its inputs are its consumption from other processing sectors. Hence, unlike M1 (where the household sector is exogenous), M2 treats the household sector like other industry in the system, i.e., endogenous. Dividing each entry in the household sector row of the Leontief inverse matrix by the corresponding direct income coefficient gives us the M2.

Table 6.5 shows different combinations of direct, indirect, and induced income effects on all the sectors of the

Table 6.5: Direct, Indirect, and Induced Income Effects for Different Sectors, Jordan 1983

Sector Number	Sector Name	Direct Income Effect (1)	Direct & Indirect Income Effect (2)	Indirect Income Effect (3)	Direct, Indirect, & Induced Income Effect (4)	Induced Income Effect (5)
1	AGRICULTURE	0.2922671	0.6500209	0.3577537	1.2680788	0.6180580
2	FERTILIZER MINERAL MINING	0.3235959	0.6883280	0.3647321	1.3428094	0.6544814
3	OTHER MINING & CRUDE OIL	0.0415231	0.0470002	0.0054770	0.0916893	0.0446891
4	GRAIN MILL PRODUCTS	0.1360577	0.5658992	0.4298415	1.1039720	0.5380727
5	BAKERY PRODUCTS	0.0822865	0.6166459	0.5343594	1.2029699	0.5863241
6	CONFECTIONERY	0.1077645	0.4469497	0.3391853	0.8719219	0.4249722
7	OTHER FOOD MANUFACTURE	0.0172775	0.4594388	0.4421613	0.8962861	0.4368472
8	PREPARED ANIMAL FOOD	0.0600290	0.4868910	0.4268620	0.9498404	0.4629495
9	BEVERAGES	0.3794740	0.6713987	0.2919247	1.3097833	0.6383846
10	TOBACCO	0.6468971	0.8446041	0.1977070	1.6476771	0.8030731
11	TEXTILE MANUFACTURE	0.0647544	0.1597973	0.0950429	0.3117369	0.1519397
12	WEARING APPAREL	0.1159449	0.2034103	0.0874654	0.3968185	0.1934082
13	LEATHER & FOOTWEAR	0.2367642	0.4544537	0.2176895	0.8865609	0.4321072
14	WOOD, CORK & FURNITURE	0.1130857	0.2611876	0.1481019	0.5095320	0.2483444
15	PAPER & PAPER PRODUCTS	0.1251898	0.3802693	0.2550795	0.7418400	0.3615707
16	PRINTING & PUBLISHING	0.2564615	0.4732690	0.2168075	0.9232663	0.4499973
17	IND. & OTHER CHEMICALS	0.1326911	0.4055745	0.2728834	0.7912061	0.3856316
18	PETROLEUM REFINERY	0.1058776	0.1794100	0.0735324	0.3499980	0.1705880
19	RUBBER & PLASTIC	0.1572544	0.3113892	0.1541348	0.6074668	0.2960776
20	POTTERY & GLASS	0.3942072	0.5732729	0.1790657	1.1183568	0.5450838
21	CEMENT, LINE & PLASTER	0.3320810	0.4749376	0.1428566	0.9265216	0.4515839
22	OTHER NON-METAL MIN. PRODS	0.3024849	0.4625785	0.1600936	0.9024109	0.4398325
23	BASIC METAL INDUSTRIES	0.0652392	0.1570642	0.0918250	0.3064053	0.1493410
24	FABRICATED METAL PRODUCTS	0.0815932	0.1426934	0.0611002	0.2783703	0.1356769
25	MACHINERY (NON-ELECTRICAL)	0.0938516	0.1957345	0.1018829	0.3818443	0.1861098
26	ELECT. & TRANSPORT EQUIP.	0.0053838	0.0572937	0.0519098	0.1117701	0.0544764
27	MISCELLANEOUS MANUFACTURING	0.0104195	0.1360963	0.1256767	0.2655004	0.1294041
28	ELECTRICITY	0.3099339	0.4917732	0.1818393	0.9593648	0.4675916
29	WATER SUPPLY	0.5748742	0.7517193	0.1768452	1.4664750	0.7147557
30	CONSTRUCTION	0.3973676	0.5954980	0.1983304	1.1617140	0.5662161
31	DISTRIBUTION	0.8061868	0.9134756	0.1072888	1.7820337	0.8685581
32	TRANSPORT & COMMUNICATION	0.3536221	0.5114836	0.1578615	0.9978165	0.4863329
33	FINANCE & BUSINESS SERVS.	0.6316413	0.7412313	0.1095900	1.4460147	0.7047834
34	HEALTH & EDUCATION	0.3978902	0.4815393	0.0836491	0.9394002	0.4578610
35	OTHER SERVICES	0.6760707	0.7484870	0.0724163	1.4601693	0.7116823

Notes: Column 3 = Column 2 - Column 1.
Column 5 = Column 4 - Column 2.

economy. It also reveals the direct and indirect and the direct and indirect and induced income effects. If we look at the column of "Direct income effect", and take the Agriculture sector as an example, then we can see that for a JD 1.0 change in the final demand for the output of Agriculture sector, the income generated directly in that sector will change by JD 0.292. Also, taking the Water Supply sector, as another example, we see that for a JD 1.0 change in the final demand for its output, then the direct income generated originally in that sector will change by JD 0.575. In the case of, to name a few, Distribution (sector 31), Other Services (sector 35), Tobacco (sector 10), and Finance and Business Services (sector 33), the direct income change due to a JD 1.0 change in the final demand for the output of the corresponding sector is, respectively, JD 0.806; JD 0.676; JD 0.647; and JD 0.632. Those sectors, along with the Water Supply sector, have the highest direct income changes generated in each one as a result of the change in the final demand of a JD 1.0 for each sector's products.

The column of "Direct and Indirect Income Effect," shown in Table 6.5, is calculated by premultiplying the direct and indirect requirements matrix, or Leontief inverse matrix, i.e., $[I-A]^{-1}$, with the row vector of household income per unit of output in value terms.[41] The result of this multiplication

[41] The dimension of the Leontief inverse matrix in this case is 35x35, where household sector is exogenous to the model. The row vector of household income has the dimension of 1x35.

gives the direct plus indirect income effect for each industry.

On the other hand, the story is different in the case of the column of "Direct, Indirect, and Induced Income Effect" in Table 6.5. In this case, the household sector is considered endogenous to the model, i.e., we include the row and the column of the household sector in the original matrix of technical coefficients, then invert the new matrix with a new dimension (36x36). Then, the household row in the new inverted matrix represents the so called Direct, Indirect, and Induced Income effect per a JD 1.0 of final demand for each industry.

To get the values of the "Indirect Income Effect" shown in Table 6.5, we subtract the values in column "Direct Income Effect" from the columns of "Direct and Indirect Income Effect." Similarly, to get the values of the "Induced Income Effect," one can subtract the values in column "Direct and Indirect Effect" from the values in column "Direct, Indirect, and Induced Income Effects."

Table 6.6 shows both income multipliers (M1 and M2) for different sectors which are calculated from information given in Table 6.5. Thus if we look at Table 6.6 we see that the value of M1 ranges between 1.107 and 26.592, with the lowest representing the sector of Other Services (sector 35), and the highest representing the sector of Other Food Manufacture (sector 7). The Water Supply sector shows that its M1 indicates that a JD 1.0 rise in the demand for its output will

Table 6.6: Type I (M1) and Type II (M2) Income Multipliers for Different Sectors, Jordan 1983

Sector Number	Sector Name	Type I Income Multiplier (M1)	Type II Income Multiplier (M2)
1	AGRICULTURE	2.2240642	4.3387663
2	FERTILIZER MINERAL MINING	2.1271220	4.1496488
3	OTHER MINING & CRUDE OIL	1.1319034	2.2081487
4	GRAIN MILL PRODUCTS	4.1592582	8.1139967
5	BAKERY PRODUCTS	7.4938871	14.6192835
6	CONFECTIONERY	4.1474688	8.0909977
7	OTHER FOOD MANUFACTURE	26.5916805	51.8757906
8	PREPARED ANIMAL FOOD	8.1109318	15.8230316
9	BEVERAGES	1.7692877	3.4515756
10	TOBACCO	1.3056236	2.5470468
I1	TEXTILE MANUFACTURE	2.4677446	4.8141449
12	WEARING APPAREL	1.7543707	3.4224752
13	LEATHER & FOOTWEAR	1.9194361	3.7444895
14	WOOD, CORK & FURNITURE	2.3096431	4.5057161
15	PAPER & PAPER PRODUCTS	3.0375419	5.9257214
16	PRINTING & PUBLISHING	1.8453802	3.6000190
17	IND. & OTHER CHEMICALS	3.0565314	5.9627665
18	PETROLEUM REFINERY	1.6945033	3.3056841
19	RUBBER & PLASTIC	1.9801619	3.8629549
20	POTTERY & GLASS	1.4542425	2.8369768
21	CEMENT, LIME & PLASTER	1.4301860	2.7900466
22	OTHER NON-METAL MIN. PRODS	1.5292613	2.9833255
23	BASIC METAL INDUSTRIES	2.4075133	4.6966440
24	FABRICATED METAL PRODUCTS	1.7488396	3.4116849
25	MACHINERY (NON-ELECTRICAL)	2.0855735	4.0685948
26	ELECT. & TRANSPORT EQUIP.	10.6418096	20.7603383
27	MISCELLANEOUS MANUFACTURING	13.0616589	25.4810477
28	ELECTRICITY	1.5867033	3.0953851
29	WATER SUPPLY	1.3076241	2.5509495
30	CONSTRUCTION	1.4986073	2.9235248
31	DISTRIBUTION	1.1330818	2.2104476
32	TRANSPORT & COMMUNICATION	1.4464130	2.8217027
33	FINANCE & BUSINESS SERVS.	1.1735003	2.2892971
34	HEALTH & EDUCATION	1.2102317	2.3609536
35	OTHER SERVICES	1.1071136	2.1597880

lead to JD 1.308 of income generated in the economy. On the other hand, a JD 1.0 increase in the final demand for the products of Other Food Manufacture sector will generate a total income of JD 26.592 in the economy. In the Miscellaneous Manufacturing sector, a JD 1.0 increase in the demand for its output will generate JD 13.062 of income in the economy.

With respect to M2, the changes in income payments by the processing sectors to the household (labor supply) will affect the level of the final demand through changes in their consumption spending. That is, the increase in the households income will trigger an increase in spending on consumer goods and services which has to be satisfied by the producing sectors. This induced income changes resulting from the changes in consumer spending will be considered in addition to the direct and indirect income effects (as already considered in M1) in M2. So M2 takes into consideration the induced effects of income changes as well as the direct and indirect income effects.

Looking at Table 6.6 we can see that M2 ranges between 2.160 and 51.876. It is also noticed that M2 is greater than M1 for each sector. This is so because of the consideration of the induced effect that stems from increase in consumer spending, which in turn is due to an increase in income.

To explain the effect of M2, let us consider, for example, the Agricultural sector. An increase in the demand for the output of the Agricultural sector by JD 1.0 will

generate JD 4.339 of additional household income (see Table 6.6). This amount reflects an increase of JD 2.115 in total household income over the M1. This increase in household income (JD 2.115) in the Agricultural sector comes from the induced effect, i.e, the chain reaction of the respending of the extra dollars in household income on goods and services.

On the other hand, if we look at the Water Supply sector we see that its M2 amounts to 2.551. This states that an increase in the demand for output of water supply by JD 1.0 would result in JD 2.551 rise in household income (see Table 6.6). Again, this amount reflects a JD 1.263 increase in total household income over M1. This extra amount of increase in household income is due to the induced effect resulting from respending the additional income on consumption of goods and services.

Examination of Table 6.6 also reveals that those sectors with high M2 are Other Food Manufacture (sector 7) with a value of 51.876; Miscellaneous Manufacturing (sector 27) with a value of 25.481; Elect. and Transport Equipment (sector 26) with a value of 20.760; Prepared Animal Food (sector 8) with a value of 15.823; and Bakery Products (sector 5) with a value of 14.62.

6.2.1.3 Employment Multipliers

The employment multipliers are used to explain the effect of changes in the demand upon the levels of employment in

different sectors. The employment levels in each sector will be measured in physical units, i.e., person-year or number of people employed by each sector.

To calculate the employment multipliers for the Jordanian economy in 1983, the input-output table (of 1983) is aggregated into nine sectors.[42] The reason for aggregating the original thirty-five sectors to nine sectors is that the data of employment in physical units in the economy are available only in an aggregated form for eight sectors. For instance, all manufacturing sectors in the basic table (Table 6.1) have been aggregated under the Mining and Manufacturing sector (see Table 6.7). However, for the Electricity sector and Water Supply sector, the employment figures were not given individually from the original source.[43] So to get the total number of employment in each sector separately, we disaggregate the total employment in both sectors using the following ratios:

$$E_j = \left(\frac{X_i}{X_T}\right) E_T \qquad (6.2)$$

(i, j = sector 28, 29)

where E_j : represents the employment level in sector j (in

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[42] For more information on the aggregation process of the thirty-five sectors into nine sectors, see United Nations (1990).

[43] The data of employment in physical units for the nine sectors for the year 1983 were given in Ministry of Labor and Social Development (1985).

Table 6.7: Employment Effects for the Aggregated Sectors, Jordan 1983

Sector Number	Sector Name	Direct Employment Effect [a] (1)	Indirect Employment Effect [a] (2)	Direct & Indirect Employment Effect [a] (3)	Induced Employment Effect [a] (4)	Direct, Indirect, & Induced Employment Effect [a] (5)
1	AGRICULTURE, HUNTING, FORESTRY, & FISHING	0.0871833	0.0733885	0.1605718	0.2056587	0.3662305
2	MINING & MANUFACTURING	0.0226097	0.0487317	0.0713413	0.1028950	0.1742363
3	ELECTRICITY	0.0609254	0.0803254	0.1412508	0.1808188	0.3220696
4	WATER SUPPLY	0.0609620	0.0490479	0.1100099	0.2499439	0.3599538
5	CONSTRUCTION	0.1650580	0.0577919	0.2228499	0.1940257	0.4168756
6	DISTRIBUTION (TRADE)	0.1636640	0.0256220	0.1892860	0.2950194	0.4843054
7	TRANSPORTATION, STORAGE, & COMMUNICATION	0.0867753	0.0534623	0.1402377	0.1762439	0.3164816
8	FINANCE, INSURANCE, REALESTATE, & BUSINESS SERVICES	0.1104526	0.0384912	0.1489437	0.2378765	0.3868202
9	OTHER SERVICES	0.4663480	0.0201268	0.4864748	0.2001306	0.6866054

Notes: [a] Measured in person-years per a JD 1000 of output.

Column 2 = Column 3 - Column 1.
Column 4 = Column 5 - Column 3.

physical units);

X_i : represents the output level of sector i (in money units);

X_T : represents the total output of both sectors, i.e., Electricity and Water Supply (in money units); and

E_T : represents the aggregated level of employment in both Electricity and Water Supply sectors (in physical units).

To be in line with what has been done in the case of income multipliers, we would use the same methodology in finding both Type I and Type II employment multipliers. An exception to this case is that employment is given in terms of physical units rather than in terms of income payments to the household. So there will be two types of employment multipliers: Type I and Type II.

Type I employment multiplier takes into consideration the effect of change in final demand on the level of employment by different sectors in the economy where the household sector is exogenous. Type I employment multiplier is given by the following equation (6.3):

$$\textit{Type I Employment Multiplier} = e_j * [I - A_g]^{-1} * e_d^{-1} \quad (6.3)$$

where

e_j : matrix of direct employment (in physical units)/ output ratios;

A_g : the aggregated input-output matrix (9 x 9);

$[I - A_g]^{-1}$: the Leontief inverse matrix of the aggregated sectors (9 x 9);

e_d : the diagonal matrix of the direct employment/ output ratio.

In the case of the Type II employment multiplier (as in the Type II Income multiplier), not only are the direct and indirect employment effects considered, but also the induced effect is added to both direct and indirect employment effects. Therefore, a modification to the matrix of the aggregated model will be applied. This modification will be represented by introducing the household sector into the system, i.e., making the household sector endogenous to the system. Then, after finding the inverse of the matrix $[I - A_g]$ we premultiply this inverted matrix by the vector of direct employment-output to get the direct, indirect, and induced employment effects. Then by dividing the new output of this multiplication by the direct employment effect for the corresponding sector, we get the Type II employment multiplier for each sector (see equation 6.3).

Table 6.7 presents different types of employment effects for the aggregated sectors of the Jordanian economy in 1983. It shows the direct, indirect, and induced employment effects. It also illustrates the total (direct plus indirect) employment effects, and the direct, indirect, and induced employment effects per JD 1000 of output. To explain these

different types of employment effects let us, as an example, look at Table 6.7 and consider the column of direct employment effect. For a JD 1000 change in the output of the Construction sector (Sector 5), for example, the employment level generated directly in that sector will change by 0.165 person-year. Also, the employment generated directly in the Water Supply sector will change by 0.061 person-year as a result of JD 1000 change in the level of its output. In the case of Agriculture and Distribution sectors, a JD 1000 change in their output leads to a direct employment change of 0.087 and 0.164 person-year, respectively.

The column of direct and indirect (or total) employment effect in Table 6.7 shows the total effect on employment in the economy as a result of a JD 1000 change in the final demand for a particular sector. For example, if the final demand for the output of the Construction sector (sector 5) changes by JD 1000, then the change in the total employment will be 0.223 person-year, of which 0.165 person-year is generated directly in the Construction sector itself, and the rest comes from those sectors that supply the Construction sector indirectly. As another example, a JD 1000 change in the final demand for the output of the Water Supply sector will generate a total employment of 0.110 person-year in the economy, of which 0.061 person-year will be generated directly in the sector of Water Supply itself. The Agricultural sector also shows that the total employment generated in the economy

as a result of a JD 1000 change in the final demand for its output amounts to 0.161 person-year, of which 0.087 person-year is generated in the Agricultural sector itself. The Distribution sector also shows that the total employment generated in the economy as a result of a JD 1000 change in the final demand for its output amounts to 0.189 person-year, of which 0.164 person-year is generated in the Distribution sector itself.

The column of the direct, indirect, and induced employment effect in Table 6.7 displays the effect of a change in the final demand on the employment level by different sectors in the economy in which the household sector is treated, in this case, as endogenous to the model. That is, the household is considered as any other industry in the model. For example, if the final demand for the output of the Construction sector (sector 5) changes by JD 1000, then the total employment generated in the economy will change by 0.417 person-year. This change in employment is as a result of the three effects combined (direct, indirect, and induced). As another example, a JD 1000 change in the final demand for the output of the Water Supply sector will generate a total employment of 0.360 person-year in the economy. The Distribution sector also shows that the total employment generated in the economy as a result of a JD 1000 change in the final demand for its output amounts to 0.484 person-year.

To get the values of the "Indirect Employment Effect,"

shown in Table 6.7, we subtract the values in column "Direct Employment Effect" from the column of "Direct and Indirect Employment Effect." Similarly, to get the values of the "Induced Employment Effect" one can subtract the values in column "Direct and Indirect Employment Effect" from the values in column "Direct, Indirect, and Induced Employment Effects."

As mentioned earlier, the employment multipliers used in this study show the total employment (in person-year) generated in the whole economy per one unit (person-year) changes in the employment of a particular sector in the economy.

Table 6.8 shows both types of employment multipliers for different sectors in the economy. It depends on the information given in Table 6.7. The column of Type I employment multiplier shows the total employment in person-year generated in the economy per one unit of employment in a certain sector of the economy. In this case the Household sector is treated as exogenous to the system. So to calculate Type I employment multiplier for each sector, we divide each entry of the column of the direct plus indirect employment effect by the corresponding entry of the column of the direct employment effect shown in Table 6.7. Hence, the result will be the so-called Type I employment multiplier for each sector in the economy. The value of Type I employment multiplier for different sectors ranges between 1.043 and 3.155 where the smallest is attributed to the sector of Other Services, and

Table 6.8: Type I (E1) and Type II (E2) Employment Multipliers for the Aggregated Sectors, Jordan 1983

Sector Number	Sector Name	Type I Employment Multiplier (E1)	Type II Employment Multiplier (E2)
1	AGRICULTURE, HUNTING, FORESTRY, & FISHING	1.8417726	4.2006961
2	MINING & MANUFACTURING	3.1553462	7.7062763
3	ELECTRICITY	2.3184230	5.2862963
4	WATER SUPPLY	1.8045662	5.9045636
5	CONSTRUCTION	1.3501312	2.5256314
6	DISTRIBUTION (TRADE)	1.1565525	2.9591444
7	TRANSPORTATION, STORAGE, & COMMUNICATION	1.6161006	3.6471370
8	FINANCE, INSURANCE, REALESTATE, & BUSINESS SERVICES	1.3484861	3.5021391
9	OTHER SERVICES	1.0431583	1.4723026

the highest is attributed to the sector of Mining and Manufacturing (see Table 6.8). Thus to explain what Type I employment multiplier means let us consider the sector of Mining and Manufacturing as an example. Its Type I employment multiplier is 3.155, which means that for every one job created in that sector, i.e., Mining and Manufacturing sector, there will be 3.155 jobs generated in the whole economy as well. Another example, for every job created in the Water Supply sector, there will be a 1.805 jobs created in the economy as a whole. Also, the Agricultural sector will generate about 1.842 jobs in the whole economy as a result of one job created in the Agricultural sector itself. Electricity sector ranks also high in terms of Type I employment multiplier. For every job created in this sector, there will be about 2.318 jobs generated in the whole economy in response (see Table 6.8).

The Type II employment multiplier for different sectors in the economy of Jordan is also given in Table 6.8. It differs from Type I in terms of considering the household sector as endogenous to the system, i.e., as any other sector in the system. So to calculate Type II employment multiplier, we divide each entry in the column of Direct, Indirect, and Induced employment effect by its corresponding entry in the column of the Direct employment effect given in Table 6.7. The result, then, will be the so-called Type II employment multiplier shown in Table 6.8. The value of Type II employment

multiplier for different sectors ranges between 1.472 and 7.706, where the smallest is attributed to the sector of Other Services, and the highest is attributed to the sector of Mining and Manufacturing (see Table 6.8). Thus to explain what Type II employment multiplier means let us consider the sector of Mining and Manufacturing as an example. Its Type II employment multiplier is 7.706, which means that for every one job created in that sector, i.e., Mining and Manufacturing sector, there will be 7.706 jobs generated in the whole economy as well. Another example, for every job created in the Water Supply sector, there will be a 5.905 jobs created in the economy as a whole. Also, the Agricultural sector will generate about 4.201 jobs in the whole economy as a result of a one job created in the Agricultural sector itself. Electricity sector ranks also high in terms of Type II employment multiplier. For every job created in this sector, there will be about 5.286 jobs generated in the whole economy in response (see Table 6.8).

6.3 Summary

This chapter has presented a brief description of the input-output tables for Jordan's economy. It has also examined the interdependence relations among the sectors of the economy. In addition, income and employment effects were examined in this chapter as well as the input-output multipliers; i.e., output, income, and employment multipliers.

After having the basic structure for empirical analysis laid down in this chapter, the next chapter will discuss the economic projections of water consumption in the economy of Jordan during the planning 1990-2000. This will be done by estimating the final demand for the years 1990, 1995, and 2000. Then estimating the water requirements for each sector in the economy and for the economy as a whole during the planning period 1990-2000.

CHAPTER 7

ECONOMIC PROJECTIONS

This chapter presents the estimation of water use by different sectors in the economy of Jordan for three phases using 1983 as the base year.

The first phase of planning is the year 1990. The final demand is estimated for this year as well as the total water use to satisfy the estimated final demand. The second phase of the plan is to find how much water will be needed to satisfy the estimated increase in final demand for the year 1995. The third phase of the planning is to estimate the total water requirements needed to satisfy the estimated final demand for the target year 2000. All of these projections are carried out by using the Leontief static open model.

This chapter is divided into three parts. In the first part, an overview of the water requirements in the Jordanian economy will be examined for the base year 1983. The water coefficients of the Jordanian economy will also be introduced. The projection analysis of both final demand and water requirements for the planning period under two alternative growth scenarios is presented in the second part. A summary concludes the chapter.

7.1 Water Requirements in the Base Year, 1983

In 1983, direct water requirements varied among different sectors in the Jordanian economy. Table 7.1 shows 1983 patterns of allocation of water output for both intermediate and final demand sectors in the economy.[44] The highest user was the Agricultural sector with a direct use (or demand) of 504.8 million cubic meters (or 133.4 billion gallons). The Industrial sector[45] used about 20.3 million cubic meters (or 5.4 billion gallons). The household direct use of water amounted to about 16.4 million cubic meters (or 4.3 billion gallons) (see Table 7.1 and Figure 7.1).

7.1.1 Water Coefficients of the Jordanian Economy

The allocation patterns of water output in Jordan in 1983 is given in Table 7.2. It demonstrates the allocation patterns of water output in terms of physical units, i.e., cubic meters. Table 7.2 reveals that about 525.2 million cubic meters (95.5 percent) of water was used to satisfy the intermediate demand by the producing sectors. Of the total intermediate demand for water, which is 525.2 million cubic meters, the agricultural sector used about 504.8 million cubic

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[44] To get the direct water requirements by different sectors in the economy in terms of physical units (i.e., cubic meter), we use two set of prices: JD 0.006 per cubic meter used for irrigated agriculture, and JD 0.25 per cubic meter used for domestic and industrial purposes. These are the average prices that the Ministry of Water and Irrigation charge the customers.

[45] It includes all other industries in the economy except Agricultural sector, i.e., sectors number 2 to 35.

Table 7.1: Patterns of Allocation of Water Output for Intermediate and Final Demand Sectors, Jordan, 1983

	Sector Name	Water Requirements (Thousand CM)	Water Requirements (Thousand Gallons)	Water Requirements (Acre-feet)
		1	2	3
	INTERMEDIATE DEMAND:			
1	AGRICULTURE	504833.33	133361820.79	408915.00
2	FERTILIZER MINERAL MINING	12.00	3170.04	9.72
3	OTHER MINING & CRUDE OIL	0.00	0.00	0.00
4	GRAIN MILL PRODUCTS	12.00	3170.04	9.72
5	BAKERY PRODUCTS	732.00	193372.44	592.92
6	CONFECTIONERY	112.00	29587.04	90.72
7	OTHER FOOD MANUFACTURE	208.00	54947.36	168.48
8	PREPARED ANIMAL FOOD	8.00	2113.36	6.48
9	BEVERAGES	1244.00	328627.48	1007.64
10	TOBACCO	36.00	9510.12	29.16
11	TEXTILE MANUFACTURE	8.00	2113.36	6.48
12	WEARING APPAREL	4.00	1056.68	3.24
13	LEATHER & FOOTWEAR	0.00	0.00	0.00
14	WOOD, CORK & FURNITURE	68.00	17963.56	55.08
15	PAPER & PAPER PRODUCTS	44.00	11623.48	35.64
16	PRINTING & PUBLISHING	8.00	2113.36	6.48
17	IND. & OTHER CHEMICALS	184.00	48607.28	149.04
18	PETROLEUM REFINERY	24.00	6340.08	19.44
19	RUBBER & PLASTIC	88.00	23246.96	71.28
20	POTTERY & GLASS	12.00	3170.04	9.72
21	CEMENT, LIME & PLASTER	176.00	46493.92	142.56
22	OTHER NONMETAL MIN. PRODS	972.00	256773.24	787.32
23	BASIC METAL INDUSTRIES	72.00	19020.24	58.32
24	FABRICATED METAL PRODUCTS	16.00	4226.72	12.96
25	MACHINERY (NONELECTRICAL)	4.00	1056.68	3.24
26	ELECT. & TRANSPORT EQUIP.	8.00	2113.36	6.48
27	MISCELLANEOUS MANUFACTURING	0.00	0.00	0.00
28	ELECTRICITY	536.00	141595.12	434.16
29	WATER SUPPLY	12.00	3170.04	9.72
30	CONSTRUCTION	728.00	192315.76	589.68
31	DISTRIBUTION	496.00	131028.32	401.76
32	TRANSPORT & COMMUNICATION	1076.00	284246.92	871.56
33	FINANCE & BUSINESS SERVS.	704.00	185975.68	570.24
34	HEALTH & EDUCATION	3024.00	798850.08	2449.44
35	OTHER SERVICES	9692.00	2560335.64	7850.52
	TOTAL INTERMEDIATE DEMAND	525153.33	138729755.19	425374.20
	FINAL DEMAND:			
36	HOUSEHOLD CONSUMPTION	16432.00	4340841.44	13309.92
37	GOVERNMENT CONSUMPTION	6960.00	1838623.20	5637.60
38	TOURISTS CONSUMPTION	1388.00	366667.96	1124.28
39	OTHER FINAL DEMAND[a]	0.00	0.00	0.00
	TOTAL FINAL DEMAND	24780.00	6546132.60	20071.80
	TOTAL OUTPUT	549933.33	145275887.79	445446.00

Note: [a] Includes Fixed Capital Formation, Net Changes in Stocks, and Exports.

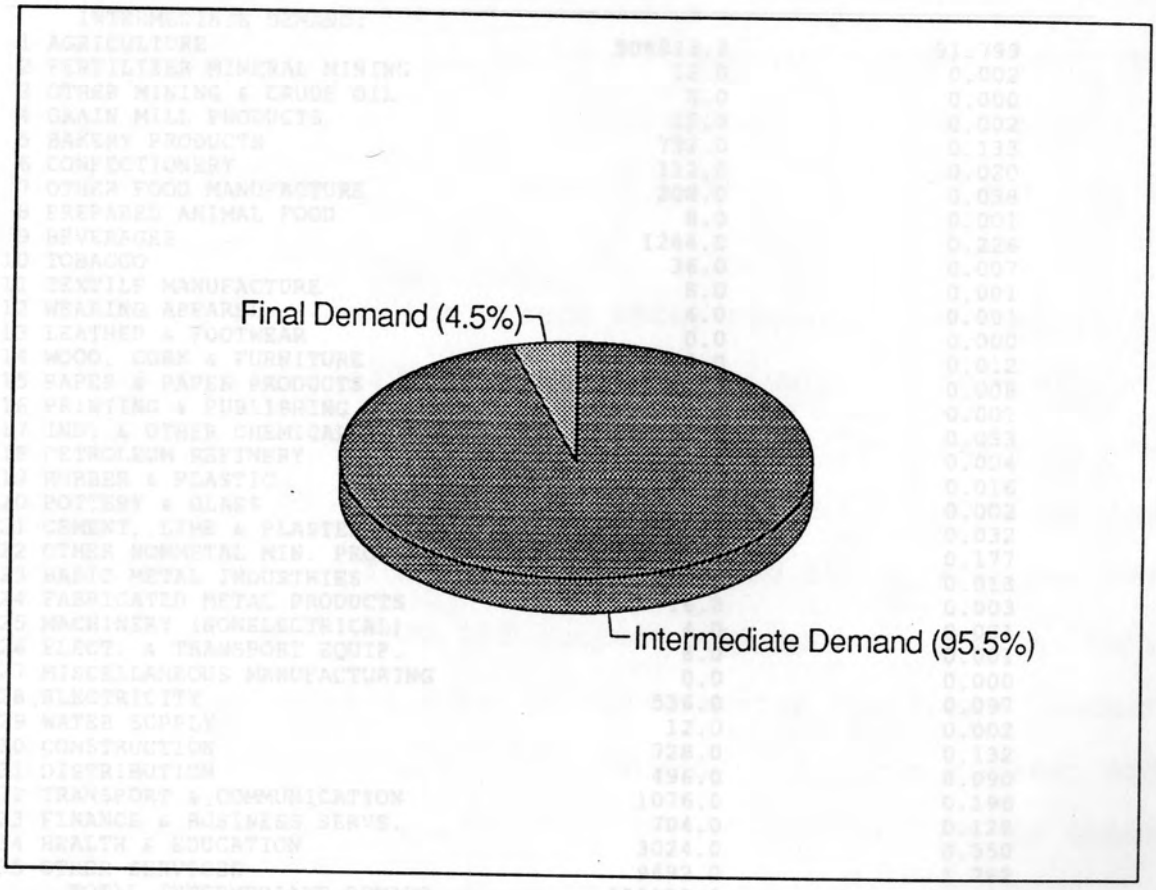

Figure 7.1: Allocation of Water Output for Intermediate and Final Demand Sectors, Jordan 1983.

Table 7.2: Patterns of Allocation of Water Output for Intermediate and Final Demand Sectors, Jordan, 1983

Sector Name	Water Output (Thousand Cubic Meter)	Water Coefficients (Percent)
	1	2
INTERMEDIATE DEMAND:		
1 AGRICULTURE	504833.3	91.799
2 FERTILIZER MINERAL MINING	12.0	0.002
3 OTHER MINING & CRUDE OIL	0.0	0.000
4 GRAIN MILL PRODUCTS	12.0	0.002
5 BAKERY PRODUCTS	732.0	0.133
6 CONFECTIONERY	112.0	0.020
7 OTHER FOOD MANUFACTURE	208.0	0.038
8 PREPARED ANIMAL FOOD	8.0	0.001
9 BEVERAGES	1244.0	0.226
10 TOBACCO	36.0	0.007
11 TEXTILE MANUFACTURE	8.0	0.001
12 WEARING APPAREL	4.0	0.001
13 LEATHER & FOOTWEAR	0.0	0.000
14 WOOD, CORK & FURNITURE	68.0	0.012
15 PAPER & PAPER PRODUCTS	44.0	0.008
16 PRINTING & PUBLISHING	8.0	0.001
17 IND. & OTHER CHEMICALS	184.0	0.033
18 PETROLEUM REFINERY	24.0	0.004
19 RUBBER & PLASTIC	88.0	0.016
20 POTTERY & GLASS	12.0	0.002
21 CEMENT, LIME & PLASTER	176.0	0.032
22 OTHER NONMETAL MIN. PRODS	972.0	0.177
23 BASIC METAL INDUSTRIES	72.0	0.013
24 FABRICATED METAL PRODUCTS	16.0	0.003
25 MACHINERY (NONELECTRICAL)	4.0	0.001
26 ELECT. & TRANSPORT EQUIP.	8.0	0.001
27 MISCELLANEOUS MANUFACTURING	0.0	0.000
28 ELECTRICITY	536.0	0.097
29 WATER SUPPLY	12.0	0.002
30 CONSTRUCTION	728.0	0.132
31 DISTRIBUTION	496.0	0.090
32 TRANSPORT & COMMUNICATION	1076.0	0.196
33 FINANCE & BUSINESS SERVS.	704.0	0.128
34 HEALTH & EDUCATION	3024.0	0.550
35 OTHER SERVICES	9692.0	1.762
TOTAL INTERMEDIATE DEMAND	525153.3	95.494
FINAL DEMAND:		
36 HOUSEHOLD CONSUMPTION	16432.0	2.988
37 GOVERNMENT CONSUMPTION	6960.0	1.266
38 TOURISTS CONSUMPTION	1388.0	0.252
39 OTHER FINAL DEMAND[a]	0.0	0.000
TOTAL FINAL DEMAND	24780.0	4.506
TOTAL OUTPUT	549933.3	100.000

Note: [a] Includes Fixed Capital Formation, Net Change in Stocks, and Exports.

meters (96.1 percent), whereas it was about 91.8 percent of total water output in 1983. The sectors of final demand, on the other hand, used directly about 24.8 million cubic meters (4.5 percent) of total water output in 1983, where about 16.4 million cubic meters (3.0 percent) of water was diverted for a direct use by the household sector. The Government sector consumed directly 7.0 million cubic meters (1.3 percent). The consumption of water by the tourists sector amounted to 1.4 million cubic meters (0.3 percent) (see Table 7.2 and Figure 7.2).

Table 7.3 shows the direct water requirements, expressed in terms of physical units (i.e., cubic meters), by different sectors per JD 100 of their output in 1983. It shows that the ranking of sectors in the economy changes in terms of the water intensity in the production process in the economy. For example, to produce JD 100 output, the Agricultural sector, Beverages sector, and Other Services sector required an amount of water equal to 134.1 cubic meters, 5.9 cubic meters, and 3.9 cubic meters, respectively. Other sectors such as Other NonMetal Mineral Products, Bakery Products, Health and Education, and Electricity used respectively, an amount of water equivalent to 2.3 cubic meters, 1.7 cubic meters, 1.5 cubic meters, and 1.03 cubic meters per JD 100 worth of their corresponding output (see Table 7.3).

Table 7.4 demonstrates the total water requirements (direct and indirect) by each sector per JD 100 of its output

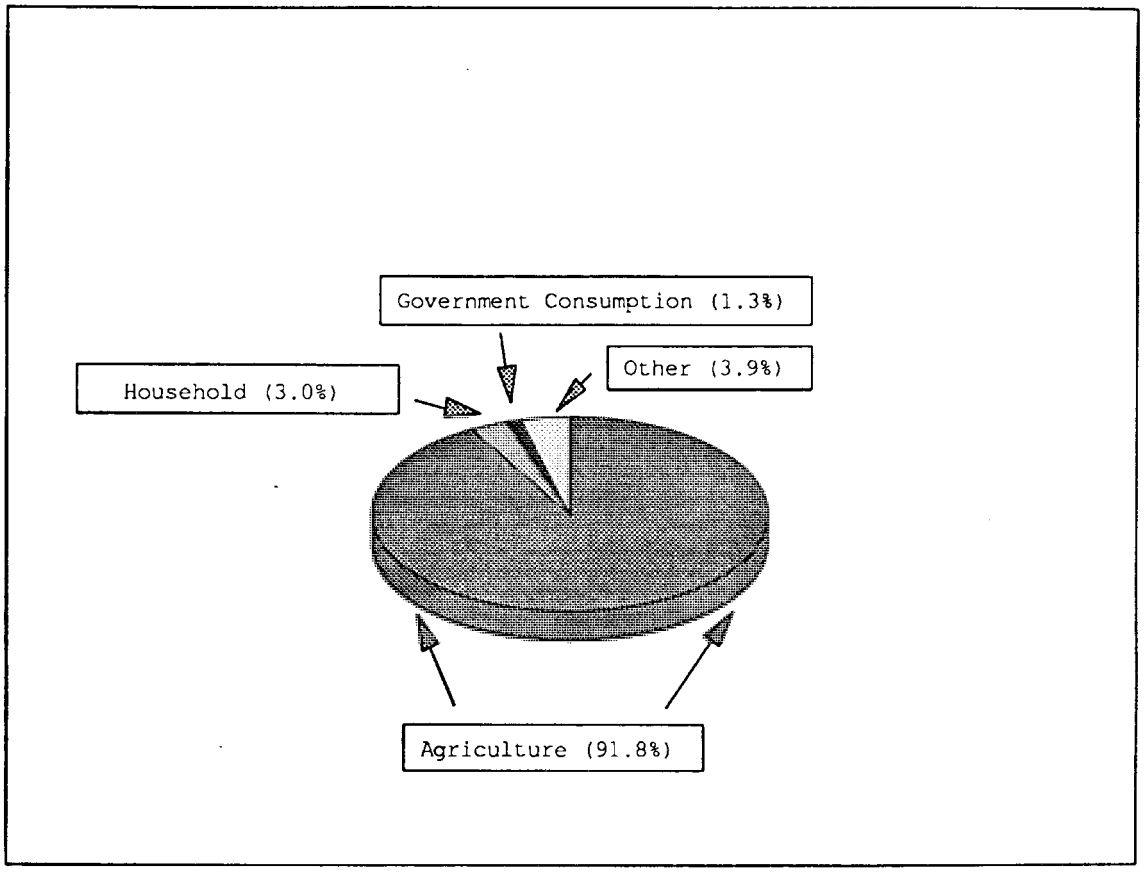

Figure 7.2: Allocation of Water Output Among its Uses, Jordan 1983.

Table 7.3: Direct Water Requirements Per JD 100 of Output, by Sector, Jordan 1983[a]

	Sector Name	Direct Water Requirements (cubic meter)
		1
1	AGRICULTURE	134.133
2	FERTILIZER MINERAL MINING	0.014
3	OTHER MINING & CRUDE OIL	0.000
4	GRAIN MILL PRODUCTS	0.049
5	BAKERY PRODUCTS	1.660
6	CONFECTIONERY	1.010
7	OTHER FOOD MANUFACTURE	0.097
8	PREPARED ANIMAL FOOD	0.041
9	BEVERAGES	5.905
10	TOBACCO	0.079
11	TEXTILE MANUFACTURE	0.017
12	WEARING APPAREL	0.011
13	LEATHER & FOOTWEAR	0.000
14	WOOD, CORK & FURNITURE	0.119
15	PAPER & PAPER PRODUCTS	0.134
16	PRINTING & PUBLISHING	0.055
17	IND. & OTHER CHEMICALS	0.137
18	PETROLEUM REFINERY	0.010
19	RUBBER & PLASTIC	0.256
20	POTTERY & GLASS	0.050
21	CEMENT, LIME & PLASTER	0.295
22	OTHER NONMETAL MIN. PRODS	2.320
23	BASIC METAL INDUSTRIES	0.078
24	FABRICATED METAL PRODUCTS	0.015
25	MACHINERY (NONELECTRICAL)	0.003
26	ELECT. & TRANSPORT EQUIP.	0.005
27	MISCELLANEOUS MANUFACTURING	0.000
28	ELECTRICITY	1.027
29	WATER SUPPLY	0.002
30	CONSTRUCTION	0.228
31	DISTRIBUTION	0.179
32	TRANSPORT & COMMUNICATION	0.243
33	FINANCE & BUSINESS SERVS.	0.596
34	HEALTH & EDUCATION	1.455
35	OTHER SERVICES	3.853

Note: [a] Except for water supply sector where it is expressed as direct water requirements per 100 cubic meters.

Table 7.4: Direct Plus Indirect Water Requirements Per JD 100 of Final Demand, by Sector, Jordan, 1983[a]

	Sector Name	Direct plus Indirect Water Requirements (cubic meter)
		1
1	AGRICULTURE	140.709
2	FERTILIZER MINERAL MINING	0.895
3	OTHER MINING & CRUDE OIL	0.006
4	GRAIN MILL PRODUCTS	70.365
5	BAKERY PRODUCTS	80.926
6	CONFECTIONERY	31.881
7	OTHER FOOD MANUFACTURE	68.569
8	PREPARED ANIMAL FOOD	68.372
9	BEVERAGES	15.976
10	TOBACCO	26.925
11	TEXTILE MANUFACTURE	2.554
12	WEARING APPAREL	0.459
13	LEATHER & FOOTWEAR	2.854
14	WOOD, CORK & FURNITURE	0.215
15	PAPER & PAPER PRODUCTS	0.659
16	PRINTING & PUBLISHING	0.303
17	IND. & OTHER CHEMICALS	0.759
18	PETROLEUM REFINERY	0.076
19	RUBBER & PLASTIC	0.595
20	POTTERY & GLASS	0.129
21	CEMENT, LIME & PLASTER	0.545
22	OTHER NONMETAL MIN. PRODS.	2.510
23	BASIC METAL INDUSTRIES	0.212
24	FABRICATED METAL PRODUCTS	0.119
25	MACHINERY (NONELECTRICAL)	0.051
26	ELECT. & TRANSPORT EQUIP.	0.027
27	MISCELLANEOUS MANUFACTURING	0.058
28	ELECTRICITY	1.401
29	WATER SUPPLY	100.013
30	CONSTRUCTION	0.754
31	DISTRIBUTION	0.334
32	TRANSPORT & COMMUNICATION	1.715
33	FINANCE & BUSINESS SERVS.	0.962
34	HEALTH & EDUCATION	3.775
35	OTHER SERVICES	4.111

Note: [a] Except for water supply sector where it is expressed as direct plus indirect water requirements per 100 cubic meters.

needed to satisfy the final demand sectors. In order to supply the final demand an amount of their output worth of JD 100, the Agricultural sector, Bakery Products sector, Grain Mill Products sector, Other Food Manufacture sector, and Prepared Animal Food sector demand a total amount of water equal to 140.7 cubic meters, 80.9 cubic meters, 70.4 cubic meters, 68.6 cubic meters, and 68.4 cubic meters, respectively. Those sectors are among the highest users of water required directly and indirectly per JD 100 of their output delivered to the final demand.

A comparison of both Table 7.3 and 7.4 shows that some of those sectors that are considered among the top fifteen in terms of their direct use of water are not necessarily in the same group of fifteen, when we consider the total use of water. For example, out of the top fifteen sectors in terms of their direct use, only eight sectors also appear in the top fifteen users of water. For example, Leather and Footwear sector has no direct use of water (see Table 7.3), but when we consider the total water use, it jumps to be among the top fifteen sectors in terms of their total use of water. Thus, all of its water use comes from indirect usage.

7.2 Projection Analysis: The Period 1990-2000

This chapter will study the water needs of the Jordanian economy over a period of time; i.e., for the years 1990, 1995, and 2000 using the Leontief open static input-output model

which has been discussed in Chapter 5. However, a small modification of the model will be made in order to get an estimate of water requirements in physical units (i.e., cubic meters) directly and indirectly in the economy. We introduce what is called a hybrid model.[46] This model has been introduced in energy analysis using the input-output approach. Using the hybrid model, the Water Supply sector will be included in the basic input-output model in terms of its physical units and other sectors will be in their value units. Once this is done, the technical coefficient matrix (A^*) will be found; then A^* will be subtracted from the identity matrix, and inverted it to find the inverse matrix, i.e., $[I-A^*]^{-1}$. Extracting the row of water supply sector from matrix A^* gives the direct water requirements, while extracting the row of Water Supply sector from the inverse matrix, i.e., $[I-A^*]^{-1}$, gives the direct plus indirect water requirements.

First we need to find the estimated vector of the new final demand for the different periods specified above for the purpose of the analysis. Then we use the applications of the Leontief inverse matrix, i.e., $[I-A]^{-1}$, to find the projected total direct and indirect output of the different industries that comprise the Jordanian economy. Once the new level of output necessary to meet the new level of final demand is found, we turn back to the table of technical coefficients,

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[46] For further information on the use of the hybrid model, see Miller and Blair (1985): ch. 6.

i.e., $[a_{ij}]$, to find the projected direct water requirements for each sector of the economy. Once again, we use the Leontief inverse matrix, i.e., $[I-A]^{-1}$ to find the total (direct plus indirect) water requirements necessary to satisfy the projected final demand for the same years used to explain this model, i.e, the years 1990, 1995, and 2000.

7.2.1 Two Alternative Growth Scenarios

For the purpose of this study, two growth scenarios are used to project the final demand sector and ultimately the water requirements for the years under consideration: 1990, 1995, and 2000. To calculate the growth rates used in the study, we took 1975-86 data from the government statistics[47] on household consumption, government consumption, and exports. Using 1983 as the base year, i.e., 1983=100, we then calculated the average annual growth rates for each of household consumption, government consumption, and exports. These annual growth rates, on average, are, respectively: 5.8 percent, 5.6 percent, and 8.1 percent. For the tourists' consumption we assume that it will grow by 3 percent from 1983 up to 1990, then it will grow by 5 percent during the period 1990 to 2000. The change in the growth rates of tourists' consumption from 3 percent to 5 percent depends on expectations that if the Middle East peace process succeed. We

[47] For more information on the basic date used in estimating the growth rates under the two alternative growth scenarios, see Central Bank of Jordan (1989).

also assume under both scenarios that the only sectors changes over time are those of household consumption, government consumption, exports, and tourists consumption. Other sectors of the final demand are assumed not to change.

Under the first growth scenario, the average annual growth rates utilized in the projections of the components of the final demand, i.e., the household consumption, the government consumption, exports, and tourists consumption are, respectively, 5.8 percent, 5.6 percent, 8.1 percent, and 3 percent until the year 1990 then 5 percent for 1990 to 2000. These growth rates are assumed to stay constant over the period of projections: 1990 to 2000. Of course, other differential growth rates across the principal components for different years may be expected by planners. The input-output methodology for projecting growth effects is still the same.

Under the second growth scenario, however, we assume that the household consumption will grow according to the population growth rate, i.e., 3.5 percent over the period 1990-1995. Then its growth rate is expected to change to 3 percent in an expectation that the population growth rate will decline to 3 percent. The government consumption, exports, and tourists consumption are assumed to grow over the period 1990-2000 at the same rates already used under the first scenario of growth, i.e., 5.6 percent, 8.1 percent, and 3 to 5 percent, respectively. Other sectors of the final demand are also assumed not to change under the second scenario of growth.

7.2.2 Projection of Final Demand Sector

The final demand sector was estimated for 1990, 1995, and 2000. Based on the first scenario of growth, Table 7.5 presents the estimated total final demand, disaggregated into its components, by sector for the Jordanian economy for the year 1990. Examining Table 7.5, we see that in year 1990, the household sector is estimated to spend about JD 1.9 billion on consumption of goods and services, of which about JD 231.6 million (or 12.2 percent) will be spent on the output of the agricultural sector, and about 24.4 million cubic meters of water will be consumed directly by the household. Also in 1990, the government sector is estimated to spend about JD 150.5 million, and about 10.2 million cubic meters of water will be needed directly to satisfy its demand. The final use of the sector of the tourist consumption will be about JD 224.7 million, and it will use directly about 1.7 million cubic meters of water. Also the total final demand in year 1990 amounts to JD 3.5 billion, whereas the total final demand for water is estimated at 36.3 million cubic meters (see Table 7.5).

Table 7.6 presents, according the second growth scenario, the estimated total final demand, disaggregated into its components, by sector for the Jordanian economy for the year 1990. Examining Table 7.6, we see that in year 1990, the household sector's estimated expenditure is about JD 1.6 billion on consumption of goods and services, of which about

Table 7.5: Estimated Total Final Demand by Sector, Jordan, 1990
(Thousands Jordanian Dinars (JDs))
(First Growth Scenario)

	SECTOR NAME	HOUSEHOLD CONSUMPTION	GOVERNMENT CONSUMPTION	EXPORTS	TOURISTS CONSUMPTION	OTHER FINAL DEMAND[a]	TOTAL FINAL DEMAND
		1	2	3	4	5	6
1	AGRICULTURE	231577.76	9407.04	57284.31	10094.80	3500.00	311863.91
2	FERTILIZER MINERAL MINING	498.58	0.00	126210.39	0.00	0.00	126708.97
3	OTHER MINING & CRUDE OIL	336.84	108.36	488.16	0.00	-4705.00	-3771.64
4	GRAIN MILL PRODUCTS	21924.37	1479.00	443.32	1783.32	0.00	25630.01
5	BAKERY PRODUCTS	60834.75	355.84	453.67	2625.78	0.00	64270.04
6	CONFECTIONERY	11805.77	275.30	705.51	1785.78	0.00	14572.36
7	OTHER FOOD MANUFACTURE	268815.80	2955.08	6749.78	13537.22	-40.00	292017.88
8	PREPARED ANIMAL FOOD	333.87	0.00	174.22	0.00	2900.00	3408.09
9	BEVERAGES	28551.39	878.62	526.11	1553.33	-362.00	31147.45
10	TOBACCO	59753.00	0.00	6085.67	1944.43	27.00	67810.10
11	TEXTILE MANUFACTURE	42669.06	2486.48	3713.85	136.52	194.00	49199.91
12	WEARING APPAREL	45472.11	2870.14	4302.06	293.94	-512.00	52426.25
13	LEATHER & FOOTWEAR	19634.74	1030.91	536.46	50.42	-26.00	21226.53
14	WOOD, CORK & FURNITURE	61828.96	79.08	6753.23	248.43	668.00	69577.70
15	PAPER & PAPER PRODUCTS	3309.06	1850.95	3101.48	988.82	-562.00	8688.31
16	PRINTING & PUBLISHING	12261.33	726.32	275.99	1939.51	0.00	15203.15
17	IND. & OTHER CHEMICALS	80684.66	1657.65	25660.55	1153.62	-400.00	108756.48
18	PETROLEUM REFINERY	69741.02	6547.15	93.15	23169.59	2000.00	101550.91
19	RUBBER & PLASTIC	3760.16	948.90	9932.34	858.45	2854.00	18353.85
20	POTTERY & GLASS	17054.27	58.57	1521.42	25.83	0.00	18660.09
21	CEMENT, LIME & PLASTER	4190.49	836.15	263.92	0.00	2000.00	7290.56
22	OTHER NONMETAL MIN. PRODS.	0.00	197.69	9670.14	0.00	2600.00	12467.83
23	BASIC METAL INDUSTRIES	0.00	373.41	1567.99	0.00	2866.00	4807.40
24	FABRICATED METAL PRODUCTS	37475.47	1722.09	5236.99	233.68	48677.00	93345.23
25	MACHINERY (NONELECTRICAL)	47306.19	21130.69	1678.39	57.80	84499.00	154672.07
26	ELECT. & TRANSPORT EQUIP.	98638.16	24223.42	2104.46	5083.07	64203.00	194252.11
27	MISCELLANEOUS MANUFACTURING	12706.49	601.85	458.84	1654.18	0.00	15421.36
28	ELECTRICITY	39339.22	3562.78	0.00	1363.93	0.00	44265.93
29	WATER SUPPLY[b]	24383.17	10191.94	0.00	1707.06	0.00	36282.17
30	CONSTRUCTION	10298.15	2416.19	0.00	0.00	304900.00	317614.34
31	DISTRIBUTION	0.00	0.00	12554.28	0.00	-4200.00	8354.28
32	TRANSPORT & COMMUNICATION	225618.48	54493.17	193901.40	66108.18	0.00	540121.23
33	FINANCE & BUSINESS SERVS.	13972.24	4694.73	72798.63	10532.64	0.00	101998.24
34	HEALTH & EDUCATION	299088.50	278.23	0.00	5768.11	0.00	305134.84
35	OTHER SERVICES	68067.20	2274.15	163319.52	71710.26	0.00	305371.13
	TOTAL (excluding water supply)	1897548.09	150519.94	718566.23	224701.64	511081.00	3502416.90

Notes: [a] Contains Fixed Capital Formation, Net Change in Stocks, and Tourists. It is assumed that they remain constant as in the base year.
[b] This row is given in physical units (i.e., Thousands cubic meters).

Table 7.6: Estimated Total Final Demand by Sector, Jordan, 1990
(Thousands Jordanian Dinars (JDs))
(Second Growth Scenario)

	SECTOR NAME	HOUSEHOLD CONSUMPTION	GOVERNMENT CONSUMPTION	EXPORTS	TOURISTS CONSUMPTION	OTHER FINAL DEMAND[a]	TOTAL FINAL DEMAND
		1	2	3	4	5	6
1	AGRICULTURE	198554.45	9407.04	57284.31	10094.80	3500.00	278840.60
2	FERTILIZER MINERAL MINING	427.49	0.00	126210.39	0.00	0.00	126637.88
3	OTHER MINING & CRUDE OIL	288.81	108.36	488.16	0.00	-4705.00	-3819.67
4	GRAIN MILL PRODUCTS	18797.93	1479.00	443.32	1783.32	0.00	22503.57
5	BAKERY PRODUCTS	52159.63	355.84	453.67	2625.78	0.00	55594.92
6	CONFECTIONERY	10122.25	275.30	705.51	1785.78	0.00	12888.84
7	OTHER FOOD MANUFACTURE	230482.29	2955.08	6749.78	13537.22	-40.00	253684.37
8	PREPARED ANIMAL FOOD	286.26	0.00	174.22	0.00	2900.00	3360.48
9	BEVERAGES	24479.93	878.62	526.11	1553.33	-362.00	27075.99
10	TOBACCO	51232.14	0.00	6085.67	1944.43	27.00	59289.24
11	TEXTILE MANUFACTURE	36584.39	2486.48	3713.85	136.52	194.00	43115.24
12	WEARING APPAREL	38987.73	2870.14	4302.06	293.94	-512.00	45941.87
13	LEATHER & FOOTWEAR	16834.80	1030.91	536.46	50.42	-26.00	18426.59
14	WOOD, CORK & FURNITURE	53012.06	79.08	6753.23	248.43	668.00	60760.80
15	PAPER & PAPER PRODUCTS	2837.18	1850.95	3101.48	988.82	-562.00	8216.43
16	PRINTING & PUBLISHING	10512.84	726.32	275.99	1939.51	0.00	13454.66
17	IND. & OTHER CHEMICALS	69178.91	1657.65	25660.55	1153.62	-400.00	97250.73
18	PETROLEUM REFINERY	59795.85	6547.15	93.15	23169.59	2000.00	91605.74
19	RUBBER & PLASTIC	3223.96	948.90	9932.34	858.45	2854.00	17817.65
20	POTTERY & GLASS	14622.31	58.57	1521.42	25.83	0.00	16228.13
21	CEMENT, LIME & PLASTER	3592.92	836.15	263.92	0.00	2000.00	6692.99
22	OTHER NONMETAL MIN. PRODS.	0.00	197.69	9670.14	0.00	2600.00	12467.83
23	BASIC METAL INDUSTRIES	0.00	373.41	1567.99	0.00	2866.00	4807.40
24	FABRICATED METAL PRODUCTS	32131.41	1722.09	5236.99	233.68	48677.00	88001.17
25	MACHINERY (NONELECTRICAL)	40560.26	21130.69	1678.39	57.80	84499.00	147926.14
26	ELECT. & TRANSPORT EQUIP.	84572.22	24223.42	2104.46	5083.07	64203.00	180186.17
27	MISCELLANEOUS MANUFACTURING	10894.53	601.85	458.84	1654.18	0.00	13609.40
28	ELECTRICITY	33729.40	3562.78	0.00	1363.93	0.00	38656.11
29	WATER SUPPLY[b]	20906.09	10191.94	0.00	1707.06	0.00	32805.09
30	CONSTRUCTION	8829.62	2416.19	0.00	0.00	304900.00	316145.81
31	DISTRIBUTION	0.00	0.00	12554.28	0.00	-4200.00	8354.28
32	TRANSPORT & COMMUNICATION	193444.97	54493.17	193901.40	66108.18	0.00	507947.72
33	FINANCE & BUSINESS SERVS.	11979.78	4694.73	72798.63	10532.64	0.00	100005.78
34	HEALTH & EDUCATION	256438.06	278.23	0.00	5768.11	0.00	262484.40
35	OTHER SERVICES	58360.72	2274.15	163319.52	71710.26	0.00	295664.65
	TOTAL (Excluding Water Supply)	1626955.10	150519.94	718566.23	224701.64	511081.00	3231823.91

Notes: [a] Contains Fixed Capital Formation, Net Change in Stocks, and Tourists. It is assumed that they remain constant as in the base year.
[b] This row is given in physical units (i.e., Thousands cubic meters).

JD 198.6 million will be spent on the output of the agricultural sector, and about 20.9 million cubic meters of water will be consumed directly by the household. Also in 1990, the government sector is estimated to spend about JD 150.5 million, and about 10.2 million cubic meters of water will be needed directly to satisfy its demand. The final use of the sector of tourists consumption will be about JD 224.7 million, and it will use directly about 1.7 million cubic meters of water. The total final demand in year 1990 amounts to JD 3.2 billion, and the total final demand for water is estimated at 32.8 million cubic meters (see Table 7.6).

Using the first scenario of growth, Table 7.7 presents the estimated total final demand, disaggregated into its components, by sector for the Jordanian economy for the year 1995. In Table 7.7, we can see that in year 1995, the household sector is expected to spend about JD 2.5 billion on consumption of goods and services, of which about JD 307.0 million (or 12.2 percent) will be spent on the output of the agricultural sector, and about 32.3 million cubic meters of water will be required as a direct demand by the household sector. The government sector is expected to spend about JD 197.7 million, and to use about 13.4 million cubic meters of water as a direct demand. The final use of the tourists consumption will be about JD 286.8 million, and it will use directly about 2.2 million cubic meters of water. The total final demand in year 1995 is expected to amount to JD 4.6

Table 7.7: Estimated Total Final Demand by Sector, Jordan, 1995
(Thousands Jordanian Dinars (JDs))
(First Growth Scenario)

	SECTOR NAME	HOUSEHOLD CONSUMPTION	GOVERNMENT CONSUMPTION	EXPORTS	TOURISTS CONSUMPTION	OTHER FINAL DEMAND[a]	TOTAL FINAL DEMAND
		1	2	3	4	5	6
1	AGRICULTURE	306990.68	12353.00	84559.84	12883.81	3500.00	420287.33
2	FERTILIZER MINERAL MINING	660.94	0.00	186304.60	0.00	0.00	186965.54
3	OTHER MINING & CRUDE OIL	446.53	142.29	720.59	0.00	-4705.00	-3395.59
4	GRAIN MILL PRODUCTS	29064.01	1942.17	654.40	2276.02	0.00	33936.6
5	BAKERY PRODUCTS	80645.49	467.28	669.68	3351.23	0.00	85133.68
6	CONFECTIONERY	15650.30	361.51	1041.43	2279.16	0.00	19332.4
7	OTHER FOOD MANUFACTURE	356355.22	3880.51	9963.64	17277.30	-40.00	387436.67
8	PREPARED ANIMAL FOOD	442.59	0.00	257.17	0.00	2900.00	3599.76
9	BEVERAGES	37849.10	1153.77	776.61	1982.49	-362.00	41399.97
10	TOBACCO	79211.47	0.00	8983.32	2481.64	27.00	90703.43
11	TEXTILE MANUFACTURE	56564.17	3265.16	5482.17	174.24	194.00	65679.74
12	WEARING APPAREL	60280.03	3768.97	6350.46	375.15	-512.00	70262.61
13	LEATHER & FOOTWEAR	26028.76	1353.76	791.89	64.35	-26.00	28212.76
14	WOOD, CORK & FURNITURE	81963.46	103.85	9968.73	317.07	668.00	93021.11
15	PAPER & PAPER PRODUCTS	4386.65	2430.60	4578.23	1262.01	-562.00	12095.49
16	PRINTING & PUBLISHING	16254.21	953.78	407.40	2475.36	0.00	20090.75
17	IND. & OTHER CHEMICALS	106959.49	2176.77	37878.64	1472.34	-400.00	148087.24
18	PETROLEUM REFINERY	92452.07	8597.49	137.50	29570.92	2000.00	132757.98
19	RUBBER & PLASTIC	4984.65	1246.06	14661.56	1095.62	2854.00	24841.89
20	POTTERY & GLASS	22607.97	76.91	2245.83	32.97	0.00	24963.68
21	CEMENT, LIME & PLASTER	5555.12	1098.00	389.58	0.00	2000.00	9042.7
22	OTHER NONMETAL MIN. PRODS.	0.00	259.60	14274.51	0.00	2600.00	17134.11
23	BASIC METAL INDUSTRIES	0.00	490.35	2314.58	0.00	2866.00	5670.93
24	FABRICATED METAL PRODUCTS	49679.30	2261.39	7730.55	298.24	48677.00	108646.48
25	MACHINERY (NONELECTRICAL)	62711.37	27748.10	2477.54	73.77	84499.00	177509.78
26	ELECT. & TRANSPORT EQUIP.	130759.51	31809.37	3106.48	6487.43	64203.00	236365.79
27	MISCELLANEOUS MANUFACTURING	16844.34	790.33	677.31	2111.20	0.00	20423.18
28	ELECTRICITY	52149.97	4678.52	0.00	1740.76	0.00	58569.25
29	WATER SUPPLY[b]	32323.51	13383.71	0.00	2178.69	0.00	47885.91
30	CONSTRUCTION	13651.73	3172.86	0.00	0.00	304900.00	321724.59
31	DISTRIBUTION	0.00	0.00	18531.91	0.00	-4200.00	14331.91
32	TRANSPORT & COMMUNICATION	299090.77	71558.57	286226.22	84372.65	0.00	741248.21
33	FINANCE & BUSINESS SERVS.	18522.28	6164.96	107461.20	13442.61	0.00	145591.05
34	HEALTH & EDUCATION	396486.18	365.36	0.00	7361.73	0.00	404213.27
35	OTHER SERVICES	90233.17	2986.34	241082.99	91522.48	0.00	425824.98
	TOTAL (excluding water supply)	2515481.53	197657.63	1060706.56	286782.55	511081.00	4571709.27

Notes: [a] Contains Fixed Capital Formation, Net Change in Stocks, and Tourists. It is assumed that they remain constant as in the base year.
[b] This row is given in physical units (i.e., Thousands cubic meters).

billion[48], and the total final demand for water is projected at 47.9 million cubic meters (see Table 7.7).

However, under the second scenario of growth, the estimated total final demand, disaggregated into its components, by sector for the Jordanian economy is given in Table 7.8 for the year 1995. Thus examining Table 7.8, we can see that in year 1995, the household sector is expected to spend about JD 1.9 billion on consumption of goods and services, of which about JD 235.8 million will be spent on the output of the agricultural sector, and about 24.8 million cubic meters of water will be required as a direct demand by the household sector. The government sector is expected to spend about JD 197.7 million, and to use about 13.4 million cubic meters of water as a direct demand. The final use of the tourist sector will be about JD 286.8 million, and it will use directly about 2.2 million cubic meters of water. The total final demand in year 1995 is expected to amount to JD 4.0 billion, and the total water for the final demand is estimated at 40.4 million cubic meters (see Table 7.8).

Table 7.9 presents under the first scenario of growth, the estimated total final demand, disaggregated into its components, by sector for the Jordanian economy for the year 2000. Thus by looking at Table 7.9, we can see that in year 2000, the households sector is expected to spend about JD 3.3

[48] Since the growth rate of the components of the final demand assumed to be constant over time, then the percentages of household consumption of each sector will be the same over the period of time.

Table 7.8: Estimated Total Final Demand by Sector, Jordan, 1995
(Thousands Jordanian Dinars (JDs))
(Second Growth Scenario)

	SECTOR NAME	HOUSEHOLD CONSUMPTION	GOVERNMENT CONSUMPTION	EXPORTS	TOURISTS CONSUMPTION	OTHER FINAL DEMAND[a]	TOTAL FINAL DEMAND
		1	2	3	4	5	6
1	AGRICULTURE	235820.40	12353.00	84559.84	12883.81	3500.00	349117.05
2	FERTILIZER MINERAL MINING	507.72	0.00	186304.60	0.00	0.00	186812.32
3	OTHER MINING & CRUDE OIL	343.02	142.29	720.59	0.00	-4705.00	-3499.10
4	GRAIN MILL PRODUCTS	22326.04	1942.17	654.40	2276.02	0.00	27198.63
5	BAKERY PRODUCTS	61949.28	467.28	669.68	3351.23	0.00	66437.47
6	CONFECTIONERY	12022.06	361.51	1041.43	2279.16	0.00	15704.16
7	OTHER FOOD MANUFACTURE	273740.66	3880.51	9963.64	17277.30	-40.00	304822.11
8	PREPARED ANIMAL FOOD	339.99	0.00	257.17	0.00	2900.00	3497.16
9	BEVERAGES	29074.48	1153.77	776.61	1982.49	-362.00	32625.35
10	TOBACCO	60847.71	0.00	8983.32	2481.64	27.00	72339.67
11	TEXTILE MANUFACTURE	43450.78	3265.16	5482.17	174.24	194.00	52566.35
12	WEARING APPAREL	46305.19	3768.97	6350.46	375.15	-512.00	56287.77
13	LEATHER & FOOTWEAR	19994.46	1353.76	791.89	64.35	-26.00	22178.46
14	WOOD, CORK & FURNITURE	62961.70	103.85	9968.73	317.07	668.00	74019.35
15	PAPER & PAPER PRODUCTS	3369.68	2430.60	4578.23	1262.01	-562.00	11078.52
16	PRINTING & PUBLISHING	12485.96	953.78	407.40	2475.36	0.00	16322.50
17	IND. & OTHER CHEMICALS	82162.84	2176.77	37878.64	1472.34	-400.00	123290.59
18	PETROLEUM REFINERY	71018.71	8597.49	137.50	29570.92	2000.00	111324.62
19	RUBBER & PLASTIC	3829.05	1246.06	14661.56	1095.62	2854.00	23686.29
20	POTTERY & GLASS	17366.72	76.91	2245.83	32.97	0.00	19722.43
21	CEMENT, LIME & PLASTER	4267.26	1098.00	389.58	0.00	2000.00	7754.84
22	OTHER NONMETAL MIN. PRODS.	0.00	259.60	14274.51	0.00	2600.00	17134.11
23	BASIC METAL INDUSTRIES	0.00	490.35	2314.58	0.00	2866.00	5670.93
24	FABRICATED METAL PRODUCTS	38162.04	2261.39	7730.55	298.24	48677.00	97129.22
25	MACHINERY (NONELECTRICAL)	48172.87	27748.10	2477.54	73.77	84499.00	162971.28
26	ELECT. & TRANSPORT EQUIP.	100445.27	31809.37	3106.48	6487.43	64203.00	206051.55
27	MISCELLANEOUS MANUFACTURING	12939.28	790.33	677.31	2111.20	0.00	16518.12
28	ELECTRICITY	40059.95	4678.52	0.00	1740.76	0.00	46479.23
29	WATER SUPPLY[b]	24829.88	13383.71	0.00	2178.69	0.00	40392.28
30	CONSTRUCTION	10486.82	3172.86	0.00	0.00	304900.00	318559.68
31	DISTRIBUTION	0.00	0.00	18531.91	0.00	-4200.00	14331.91
32	TRANSPORT & COMMUNICATION	229751.94	71558.57	286226.22	84372.65	0.00	671909.38
33	FINANCE & BUSINESS SERVS.	14228.22	6164.96	107461.20	13442.61	0.00	141296.99
34	HEALTH & EDUCATION	304567.97	365.36	0.00	7361.73	0.00	312295.06
35	OTHER SERVICES	69314.23	2986.34	241082.99	91522.48	0.00	404906.04
	TOTAL (Excluding Water Supply)	1932312.30	197657.63	1060706.56	286782.55	511081.00	3988540.04

Notes: [a] Contains Fixed Capital Formation, Net Change in Stocks, and Tourists. It is assumed that they remain constant as in the base year.
[b] This row is given in physical units (i.e., Thousands cubic meters).

Table 7.9: Estimated Total Final Demand by Sector, Jordan, 2000
(Thousands Jordanian Dinars (JDs))
(First Growth Scenario)

SECTOR NAME	HOUSEHOLD CONSUMPTION	GOVERNMENT CONSUMPTION	EXPORTS	TOURISTS CONSUMPTION	OTHER FINAL DEMAND[a]	TOTAL FINAL DEMAND
	1	2	3	4	5	6
1 AGRICULTURE	406961.69	16221.54	124822.43	16443.37	3500.00	567949.03
2 FERTILIZER MINERAL MINING	876.17	0.00	275012.26	0.00	0.00	275888.43
3 OTHER MINING & CRUDE OIL	591.94	186.85	1063.69	0.00	-4705.00	-2862.52
4 GRAIN MILL PRODUCTS	38528.66	2550.39	965.99	2904.84	0.00	44949.88
5 BAKERY PRODUCTS	106907.56	613.62	988.54	4277.11	0.00	112786.83
6 CONFECTIONERY	20746.79	474.72	1537.30	2908.85	0.00	25667.66
7 OTHER FOOD MANUFACTURE	472401.71	5095.75	14707.76	22050.70	-40.00	514215.92
8 PREPARED ANIMAL FOOD	586.72	0.00	379.62	0.00	2900.00	3866.34
9 BEVERAGES	50174.60	1515.09	1146.39	2530.22	-362.00	55004.3
10 TOBACCO	105006.56	0.00	13260.67	3167.27	27.00	121461.5
11 TEXTILE MANUFACTURE	74984.20	4287.70	8092.47	222.38	194.00	87780.75
12 WEARING APPAREL	79910.12	4949.28	9374.19	478.80	-512.00	94200.39
13 LEATHER & FOOTWEAR	34504.98	1777.71	1168.94	82.13	-26.00	37507.76
14 WOOD, CORK & FURNITURE	108654.73	136.37	14715.27	404.67	668.00	124579.04
15 PAPER & PAPER PRODUCTS	5815.16	3191.78	6758.12	1610.68	-562.00	16813.74
16 PRINTING & PUBLISHING	21547.37	1252.47	601.38	3159.26	0.00	26560.48
17 IND. & OTHER CHEMICALS	141790.67	2858.46	55914.29	1879.12	-400.00	202042.54
18 PETROLEUM REFINERY	122558.93	11289.93	202.97	37740.82	2000.00	173792.65
19 RUBBER & PLASTIC	6607.89	1636.28	21642.56	1398.32	2854.00	34139.05
20 POTTERY & GLASS	29970.22	101.00	3315.17	42.08	0.00	33428.47
21 CEMENT, LIME & PLASTER	7364.14	1441.86	575.08	0.00	2000.00	11381.08
22 OTHER NONMETAL MIN. PRODS.	0.00	340.90	21071.22	0.00	2600.00	24012.12
23 BASIC METAL INDUSTRIES	0.00	643.91	3416.65	0.00	2866.00	6926.56
24 FABRICATED METAL PRODUCTS	65857.28	2969.58	11411.40	380.64	48677.00	129295.9
25 MACHINERY (NONELECTRICAL)	83133.22	36437.86	3657.20	94.15	84499.00	207821.43
26 ELECT. & TRANSPORT EQUIP.	173341.13	41770.98	4585.61	8279.79	64203.00	292180.51
27 MISCELLANEOUS MANUFACTURING	22329.67	1037.83	999.81	2694.49	0.00	27061.8
28 ELECTRICITY	69132.52	6143.67	0.00	2221.70	0.00	77497.89
29 WATER SUPPLY[b]	42849.61	17575.03	0.00	2780.62	0.00	63205.26
30 CONSTRUCTION	18097.39	4166.49	0.00	0.00	304900.00	327163.88
31 DISTRIBUTION	0.00	0.00	27355.75	0.00	-4200.00	23155.75
32 TRANSPORT & COMMUNICATION	396489.19	93968.27	422510.87	107683.26	0.00	1020651.59
33 FINANCE & BUSINESS SERVS.	24554.03	8095.62	158628.11	17156.56	0.00	208434.32
34 HEALTH & EDUCATION	525601.25	479.78	0.00	9395.64	0.00	535476.67
35 OTHER SERVICES	119617.45	3921.56	355873.00	116808.45	0.00	596220.46
TOTAL (excluding water supply)	3334643.94	259557.25	1565754.71	366015.30	511081.00	6037052.2

Notes: [a] Contains Fixed Capital Formation, Net Change in Stocks, and Tourists. It is assumed that they remain constant as in the base year.
[b] This row is given in physical units (i.e., Thousands cubic meters).

billion on consumption of goods and services, of which about JD 407.0 million (or 12.2 percent) will be spent on the output of the agricultural sector, and about 42.8 million cubic meters of water will be required as a direct demand by the household sector. The government sector is expected to spend about JD 259.6 million, and to use about 17.6 million cubic meters of water as a direct demand. The final use of the tourists sector will be about JD 366.0 million, and it will use directly about 2.8 million cubic meters of water. The total final demand in year 2000 is expected to amount to JD 6.0 billion, and the total water for the final demand is estimated at 63.2 million cubic meter (see Table 7.9).

However, under the second growth scenario, the estimated total final demand, disaggregated into its components, by sector for the Jordanian economy is given in Table 7.10 for the year 2000. Thus examining Table 7.10, we can see that in year 2000, the households sector is expected to spend about JD 2.2 billion on consumption of goods and services, of which about JD 273.4 million will be spent on the output of the agricultural sector, and about 28.8 million cubic meters of water will be required as a direct demand by the household sector. The government sector is expected to spend about JD 259.6 million, and to use about 17.6 million cubic meters of water as a direct demand. The final use of the tourists sector will be about JD 366.0 million, and it will use directly about 2.8 million cubic meters of water. The total final

Table 7.10: Estimated Total Final Demand by Sector, Jordan, 2000
(Thousands Jordanian Dinars (JDs))
(Second Growth Scenario)

SECTOR NAME	HOUSEHOLD CONSUMPTION	GOVERNMENT CONSUMPTION	EXPORTS	TOURISTS CONSUMPTION	OTHER FINAL DEMAND[a]	TOTAL FINAL DEMAND
	1	2	3	4	5	6
1 AGRICULTURE	273380.48	16221.54	124822.43	16443.37	3500.00	434367.82
2 FERTILIZER MINERAL MINING	588.59	0.00	275012.26	0.00	0.00	275600.85
3 OTHER MINING & CRUDE OIL	397.65	186.85	1063.69	0.00	-4705.00	-3056.81
4 GRAIN MILL PRODUCTS	25882.00	2550.39	965.99	2904.84	0.00	32303.22
5 BAKERY PRODUCTS	71816.19	613.62	988.54	4277.11	0.00	77695.46
6 CONFECTIONERY	13936.86	474.72	1537.30	2908.85	0.00	18857.73
7 OTHER FOOD MANUFACTURE	317340.45	5095.75	14707.76	22050.70	-40.00	359154.66
8 PREPARED ANIMAL FOOD	394.14	0.00	379.62	0.00	2900.00	3673.76
9 BEVERAGES	33705.29	1515.09	1146.39	2530.22	-362.00	38534.99
10 TOBACCO	70539.17	0.00	13260.67	3167.27	27.00	86994.11
11 TEXTILE MANUFACTURE	50371.36	4287.70	8092.47	222.38	194.00	63167.91
12 WEARING APPAREL	53680.41	4949.28	9374.19	478.80	-512.00	67970.68
13 LEATHER & FOOTWEAR	23179.06	1777.71	1168.94	82.13	-26.00	26181.84
14 WOOD, CORK & FURNITURE	72989.87	136.37	14715.27	404.67	668.00	88914.18
15 PAPER & PAPER PRODUCTS	3906.38	3191.78	6758.12	1610.68	-562.00	14904.96
16 PRINTING & PUBLISHING	14474.65	1252.47	601.38	3159.26	0.00	19487.76
17 IND. & OTHER CHEMICALS	95249.25	2858.46	55914.29	1879.12	-400.00	155501.12
18 PETROLEUM REFINERY	82330.15	11289.93	202.97	37740.82	2000.00	133563.87
19 RUBBER & PLASTIC	4438.92	1636.28	21642.56	1398.32	2854.00	31970.08
20 POTTERY & GLASS	20132.79	101.00	3315.17	42.08	0.00	23591.04
21 CEMENT, LIME & PLASTER	4946.92	1441.86	575.08	0.00	2000.00	8963.86
22 OTHER NONMETAL MIN. PRODS.	0.00	340.90	21071.22	0.00	2600.00	24012.12
23 BASIC METAL INDUSTRIES	0.00	643.91	3416.65	0.00	2866.00	6926.56
24 FABRICATED METAL PRODUCTS	44240.26	2969.58	11411.40	380.64	48677.00	107678.88
25 MACHINERY (NONELECTRICAL)	55845.56	36437.86	3657.20	94.15	84499.00	180533.77
26 ELECT. & TRANSPORT EQUIP.	116443.60	41770.98	4585.61	8279.79	64203.00	235282.98
27 MISCELLANEOUS MANUFACTURING	15000.17	1037.83	999.81	2694.49	0.00	19732.3
28 ELECTRICITY	46440.46	6143.67	0.00	2221.70	0.00	54805.83
29 WATER SUPPLY[b]	28784.64	17575.03	0.00	2780.62	0.00	49140.29
30 CONSTRUCTION	12157.10	4166.49	0.00	0.00	304900.00	321223.59
31 DISTRIBUTION	0.00	0.00	27355.75	0.00	-4200.00	23155.75
32 TRANSPORT & COMMUNICATION	266345.47	93968.27	422510.87	107683.26	0.00	890507.87
33 FINANCE & BUSINESS SERVS.	16494.41	8095.62	158628.11	17156.56	0.00	200374.7
34 HEALTH & EDUCATION	353077.75	479.78	0.00	9395.64	0.00	362953.17
35 OTHER SERVICES	80354.19	3921.56	355873.00	116808.45	0.00	556957.2
TOTAL (Excluding Water Supply)	2240079.55	259557.25	1565754.71	366015.30	511081.00	4942487.81

Notes: [a] Contains Fixed Capital Formation, Net Change in Stocks, and Tourists. It is assumed that they remain constant as in the base year.
[b] This row is given in physical units (i.e., Thousands cubic meters).

demand in year 2000 is expected to amount to JD 4.9 billion, and the total water for final demand is estimated at 49.1 million cubic meters (see Table 7.10).

7.2.3 Projection of Water Requirements

This section will present the projections of direct water requirements along with the total water requirements, (direct plus indirect), needed to satisfy the final demand estimated for the years 1990, 1995, and 2000 for each scenario.[49]

7.2.3.1 The Projected Direct Water Requirements

Direct water requirements or demand for water are estimated by sector for the years 1990, 1995, and 2000. These projections are based on the assumptions of constant technical coefficients of production, i.e., a_{ij}, and the new level of output needed to support the newly final demand sector for each of those years.

Table 7.11 presents under the first scenario of growth the allocation patterns of water for each sector in the economy of Jordan estimated for the year 1990. In this table, the total intermediate demand for water is estimated to be about 781.8 million cubic meters (or 633.2 thousand acre-

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[49] Direct water requirements meant here the same row of water supply, i.e., row 29 in the basic table of input-output Table A.1. That is, $a_{ij}*X'_j = w_{35j}$, where w_{35j} is the sales of water supply sector to other sectors in the economy. X'_j is the new level of output by each sector necessary to meet the new level of final demand, and a_{ij} is the technical coefficients.

Table 7.11: Patterns of Allocation of Water Output Estimated for Intermediate and Final Demand Sectors, Jordan, 1990 (First Growth Scenario)

	Sector Name	Water Requirements (Thousand CM)	Water Requirements (Thousand Gallons)	Water Requirements (Acre-feet)
		1	2	3
	INTERMEDIATE DEMAND:			
1	AGRICULTURE	752226.26	198715611.10	609303.27
2	FERTILIZER MINERAL MINING	20.23	5344.16	16.39
3	OTHER MINING & CRUDE OIL	0.00	0.00	0.00
4	GRAIN MILL PRODUCTS	17.61	4652.03	14.26
5	BAKERY PRODUCTS	1078.24	284838.66	873.37
6	CONFECTIONERY	163.39	43162.74	132.35
7	OTHER FOOD MANUFACTURE	306.50	80968.11	248.27
8	PREPARED ANIMAL FOOD	11.33	2993.05	9.18
9	BEVERAGES	1841.00	486336.97	1491.21
10	TOBACCO	53.77	14204.42	43.55
11	TEXTILE MANUFACTURE	11.97	3162.11	9.70
12	WEARING APPAREL	6.02	1590.30	4.88
13	LEATHER & FOOTWEAR	0.00	0.00	0.00
14	WOOD, CORK & FURNITURE	101.01	26683.81	81.82
15	PAPER & PAPER PRODUCTS	65.32	17255.58	52.91
16	PRINTING & PUBLISHING	11.69	3088.15	9.47
17	IND. & OTHER CHEMICALS	276.04	72921.49	223.59
18	PETROLEUM REFINERY	35.17	9290.86	28.49
19	RUBBER & PLASTIC	129.55	34223.22	104.94
20	POTTERY & GLASS	17.49	4620.33	14.17
21	CEMENT, LIME & PLASTER	190.65	50364.01	154.43
22	OTHER NONMETAL MIN. PRODS.	1122.70	296583.66	909.39
23	BASIC METAL INDUSTRIES	76.87	20306.75	62.26
24	FABRICATED METAL PRODUCTS	19.10	5045.65	15.47
25	MACHINERY (NONELECTRICAL)	4.77	1260.09	3.86
26	ELECT. & TRANSPORT EQUIP.	10.35	2734.16	8.38
27	MISCELLANEOUS MANUFACTURING	0.00	0.00	0.00
28	ELECTRICITY	786.23	207698.38	636.85
29	WATER SUPPLY	17.85	4715.43	14.46
30	CONSTRUCTION	743.82	196494.93	602.49
31	DISTRIBUTION	726.34	191877.24	588.34
32	TRANSPORT & COMMUNICATION	1636.65	432353.83	1325.69
33	FINANCE & BUSINESS SERVS.	1084.85	286584.82	878.73
34	HEALTH & EDUCATION	4470.07	1180858.39	3620.76
35	OTHER SERVICES	14551.83	3844156.93	11786.98
	TOTAL INTERMEDIATE DEMAND	781814.67	206531981.36	633269.91
	FINAL DEMAND:			
36	HOUSEHOLD CONSUMPTION	24383.17	6441302.02	19750.37
37	GOVERNMENT CONSUMPTION	10191.94	2692404.79	8255.47
38	TOURISTS CONSUMPTION	1707.06	450954.04	1382.72
39	OTHER FINAL DEMAND[a]	0.00	0.00	0.00
	TOTAL FINAL DEMAND	36282.17	9584660.85	29388.56
	TOTAL OUTPUT	818096.84	216116642.21	662658.47

Note: [a] Includes Fixed Capital Formation, Net Changes in Stocks, and Exports.

feet), of which the agricultural sector direct demand of water is estimated to reach about 752.2 million cubic meters (or 609.3 thousand acre-feet). For the other industries, excluding agriculture, the total intermediate demand for water is expected to amount to 29.6 million cubic meters (or 24.0 thousand acre-feet). Further examination of Table 7.11 reveals, for example, that sectors of Other Services, Health and Education, Transport and Communication, Beverages, Other NonMetal Products, and Bakery Products have a higher direct water demand, respectively, 14.6 millon cubic meters (or 11.8 thousand acre-feet), 4.5 millon cubic meters (or 3.6 thousand acre-feet), 1.6 million cubic meters (or 1.3 thousand acre-feet), 1.8 million cubic meters (or 1.5 thousand acre-feet), 1.1 million cubic meters (or 909.4 acre-feet), and 1.1 thousand cubic meters (or 873.4 acre-feet).

In other words, the agricultural sector, in terms of its direct use, is the heavy user of water in the economy, where its direct use is estimated to be about 92.0 percent of the total water allocated in the economy in 1990. Whereas the direct use of water by both other industries, excluding agriculture, and the final demand sectors is estimated to be about 3.6 percent and 4.4 percent, respectively (see Table 7.11).

Table 7.12 presents under the second scenario of growth the allocation patterns of water for each sector in the economy of Jordan estimated for the year 1990. In this table,

Table 7.12: Patterns of Allocation of Water Output Estimated for Intermediate and Final Demand Sectors, Jordan, 1990 (Second Growth Scenario)

	Sector Name	Water Requirements (Thousand CM)	Water Requirements (Thousand Gallons)	Water Requirements (Acre-feet)
		1	2	3
	INTERMEDIATE DEMAND:			
1	AGRICULTURE	665626.64	175838589.49	539157.58
2	FERTILIZER MINERAL MINING	19.91	5259.62	16.13
3	OTHER MINING & CRUDE OIL	0.00	0.00	0.00
4	GRAIN MILL PRODUCTS	15.41	4070.86	12.48
5	BAKERY PRODUCTS	932.98	246465.33	755.71
6	CONFECTIONERY	144.52	38177.85	117.06
7	OTHER FOOD MANUFACTURE	266.58	70422.44	215.93
8	PREPARED ANIMAL FOOD	10.17	2686.61	8.24
9	BEVERAGES	1600.35	422764.46	1296.28
10	TOBACCO	47.01	12418.63	38.08
11	TEXTILE MANUFACTURE	10.55	2786.99	8.55
12	WEARING APPAREL	5.28	1394.82	4.28
13	LEATHER & FOOTWEAR	0.00	0.00	0.00
14	WOOD, CORK & FURNITURE	88.71	23434.52	71.86
15	PAPER & PAPER PRODUCTS	59.15	15625.66	47.91
16	PRINTING & PUBLISHING	10.50	2773.79	8.51
17	IND. & OTHER CHEMICALS	248.22	65572.28	201.06
18	PETROLEUM REFINERY	32.52	8590.81	26.34
19	RUBBER & PLASTIC	122.45	32347.62	99.18
20	POTTERY & GLASS	15.98	4221.44	12.94
21	CEMENT, LIME & PLASTER	186.75	49333.75	151.27
22	OTHER NONMETAL MIN. PRODS.	1109.94	293212.85	899.05
23	BASIC METAL INDUSTRIES	75.73	20005.59	61.34
24	FABRICATED METAL PRODUCTS	18.04	4765.63	14.61
25	MACHINERY (NONELECTRICAL)	4.56	1204.62	3.69
26	ELECT. & TRANSPORT EQUIP.	9.63	2543.96	7.80
27	MISCELLANEOUS MANUFACTURING	0.00	0.00	0.00
28	ELECTRICITY	708.70	187217.28	574.05
29	WATER SUPPLY	15.84	4184.45	12.83
30	CONSTRUCTION	739.05	195234.84	598.63
31	DISTRIBUTION	655.42	173142.30	530.89
32	TRANSPORT & COMMUNICATION	1538.35	406385.92	1246.06
33	FINANCE & BUSINESS SERVS.	1036.79	273888.81	839.80
34	HEALTH & EDUCATION	3847.76	1016462.76	3116.69
35	OTHER SERVICES	14042.84	3709697.04	11374.70
	TOTAL INTERMEDIATE DEMAND	693246.33	183134883.02	561529.53
	FINAL DEMAND:			
36	HOUSEHOLD CONSUMPTION	20906.09	5522761.80	16933.93
37	GOVERNMENT CONSUMPTION	10191.94	2692404.79	8255.47
38	TOURISTS CONSUMPTION	1707.06		
39	OTHER FINAL DEMAND[a]	0.00	0.00	0.00
	TOTAL FINAL DEMAND	32805.09	8215166.59	25189.40
	TOTAL OUTPUT	726051.42	191350049.61	586718.93

Note: [a] Includes Fixed Capital Formation, Net Changes in Stocks, and Exports.

the total intermediate demand for water is estimated to be about 693.2 million cubic meters (or 561.5 thousand acre-feet), of which the agricultural sector direct demand of water is estimated to reach about 665.6 million cubic meters (or 539.2 thousand acre-feet). For the other industries, excluding agriculture, the total intermediate demand for water is expected to amount to 27.6 million cubic meters (or 22.4 thousand acre-feet). Further examination of Table 7.12 reveals, for example, that sectors of Other Services, Health and Education, Beverages, Transport and Communication, Other NonMetal Products, and Bakery Products have a higher direct water demand, respectively, 14.0 millon cubic meters (or 11.4 thousand acre-feet), 3.8 millon cubic meters (or 3.1 thousand acre-feet), 1.6 million cubic meters (or 1.3 thousand acre-feet), 1.5 million cubic meters (or 1.2 thousand acre-feet), 1.1 million cubic meters (or 899.1 acre-feet), and 933.0 thousand cubic meters (or 755.7 acre-feet).

In other words, the agricultural sector, in terms of its direct use, is the heavy user of water in the economy, where its direct use is estimated to be about 92.0 percent of the total water allocated in the economy in 1990. The direct use of water by both other industries, excluding agriculture, and the final demand sectors is estimated to be about 3.8 percent and 4.5 percent, respectively (see Table 7.12).

Table 7.13 presents, for the year 1995, the estimated patterns of water allocation among different sectors of the

Table 7.13: Patterns of Allocation of Water Output Estimated for Intermediate and Final Demand Sectors, Jordan, 1995 (First Growth Scenario)

	Sector Name	Water Requirements (Thousand CM)	Water Requirements (Thousand Gallons)	Water Requirements (Acre-feet)
		1	2	3
	INTERMEDIATE DEMAND:			
1	AGRICULTURE	1006981.42	266014281.72	815654.95
2	FERTILIZER MINERAL MINING	29.45	7779.81	23.85
3	OTHER MINING & CRUDE OIL	0.00	0.00	0.00
4	GRAIN MILL PRODUCTS	23.32	6160.44	18.89
5	BAKERY PRODUCTS	1428.46	377356.28	1157.05
6	CONFECTIONERY	216.91	57301.11	175.70
7	OTHER FOOD MANUFACTURE	406.61	107414.16	329.35
8	PREPARED ANIMAL FOOD	14.75	3896.51	11.95
9	BEVERAGES	2446.98	646418.71	1982.05
10	TOBACCO	71.92	18999.11	58.26
11	TEXTILE MANUFACTURE	16.02	4232.00	12.98
12	WEARING APPAREL	8.07	2131.85	6.54
13	LEATHER & FOOTWEAR	0.00	0.00	0.00
14	WOOD, CORK & FURNITURE	134.68	35578.42	109.09
15	PAPER & PAPER PRODUCTS	87.64	23151.86	70.99
16	PRINTING & PUBLISHING	15.57	4113.13	12.61
17	IND. & OTHER CHEMICALS	371.95	98258.03	301.28
18	PETROLEUM REFINERY	47.20	12468.82	38.23
19	RUBBER & PLASTIC	174.71	46153.14	141.52
20	POTTERY & GLASS	23.33	6163.09	18.90
21	CEMENT, LIME & PLASTER	205.95	54405.81	166.82
22	OTHER NONMETAL MIN. PRODS.	1289.35	340607.59	1044.37
23	BASIC METAL INDUSTRIES	82.03	21669.87	66.44
24	FABRICATED METAL PRODUCTS	22.28	5885.71	18.05
25	MACHINERY (NONELECTRICAL)	5.55	1466.14	4.50
26	ELECT. & TRANSPORT EQUIP.	12.77	3373.45	10.34
27	MISCELLANEOUS MANUFACTURING	0.00	0.00	0.00
28	ELECTRICITY	1046.24	276385.22	847.45
29	WATER SUPPLY	23.88	6308.38	19.34
30	CONSTRUCTION	760.07	200787.69	615.66
31	DISTRIBUTION	966.22	255246.34	782.64
32	TRANSPORT & COMMUNICATION	2246.95	593576.78	1820.03
33	FINANCE & BUSINESS SERVS.	1505.29	397652.46	1219.28
34	HEALTH & EDUCATION	5922.69	1564597.02	4797.38
35	OTHER SERVICES	20079.43	5304383.02	16264.34
	TOTAL INTERMEDIATE DEMAND	1046667.69	276498203.67	847800.83
	FINAL DEMAND:			
36	HOUSEHOLD CONSUMPTION	32323.51	8538901.64	26182.04
37	GOVERNMENT CONSUMPTION	13383.71	3535574.67	10840.81
38	TOURISTS CONSUMPTION	2178.69	575544.54	1764.74
39	OTHER FINAL DEMAND[a]	0.00	0.00	0.00
	TOTAL FINAL DEMAND	47885.91	12650020.85	38787.59
	TOTAL OUTPUT	1094553.60	289148224.52	886588.42

Note: [a] Includes Fixed Capital Formation, Net Changes in Stocks, and Exports.

Jordanian economy using the first scenario of growth. As Table 7.13 shows, the total intermediate demand for water is estimated to be about 1046.7 million cubic meter (or 847.8 thousand acre-feet), of which the Agriculture sector has the highest direct water use among other sectors. Its direct demand of water is expected to reach about 1007.0 million cubic meter (or 815.7 thousand acre-feet). That is, the agricultural direct demand of water grows, on average, at about 6 percent per year over the period of 1990-1995. On the other hand, the industrial sector direct demand for water, excluding agriculture, is expected to amount to 39.7 million cubic meters (or 32.1 thousand acre-feet) in 1995. That is, an average increase of about 6.0 percent per annum between the years 1990 and 1995. The direct water requirements by the sectors of final demand is estimated to be equal to 47.9 million cubic meters (or 38.8 thousand acre-feet) in the year 1995, of which the household direct demand of water will comprise about 32.3 million cubic meters (or 26.2 thousand acre-feet) (see Table 7.13).

Table 7.14 presents the estimated 1995 patterns of water allocation among different sectors of the Jordanian economy using the second scenario of growth. It shows the total intermediate demand for water is estimated to be about 855.8 million cubic meters (or 693.2 thousand acre-feet), of which the Agriculture sector has the highest direct water use among other sectors. Its direct demand of water is expected to reach

Table 7.14: Patterns of Allocation of Water Output Estimated for Intermediate and Final Demand Sectors, Jordan, 1995 (Second Growth Scenario)

	Sector Name	Water Requirements (Thousand CM)	Water Requirements (Thousand Gallons)	Water Requirements (Acre-feet)
		1	2	3
	INTERMEDIATE DEMAND:			
1	AGRICULTURE	820346.00	216710802.82	664480.26
2	FERTILIZER MINERAL MINING	28.76	7597.53	23.30
3	OTHER MINING & CRUDE OIL	0.00	0.00	0.00
4	GRAIN MILL PRODUCTS	18.57	4905.64	15.04
5	BAKERY PRODUCTS	1115.40	294655.22	903.47
6	CONFECTIONERY	176.25	46559.96	142.76
7	OTHER FOOD MANUFACTURE	320.56	84682.34	259.65
8	PREPARED ANIMAL FOOD	12.26	3238.72	9.93
9	BEVERAGES	1928.35	509412.22	1561.96
10	TOBACCO	57.36	15152.79	46.46
11	TEXTILE MANUFACTURE	12.95	3421.00	10.49
12	WEARING APPAREL	6.48	1711.82	5.25
13	LEATHER & FOOTWEAR	0.00	0.00	0.00
14	WOOD, CORK & FURNITURE	108.16	28572.63	87.61
15	PAPER & PAPER PRODUCTS	74.35	19641.04	60.22
16	PRINTING & PUBLISHING	13.01	3436.85	10.54
17	IND. & OTHER CHEMICALS	312.00	82421.04	252.72
18	PETROLEUM REFINERY	41.49	10960.41	33.61
19	RUBBER & PLASTIC	159.40	42108.70	129.11
20	POTTERY & GLASS	20.07	5301.89	16.26
21	CEMENT, LIME & PLASTER	197.53	52181.50	160.00
22	OTHER NONMETAL MIN. PRODS.	1261.86	333345.56	1022.11
23	BASIC METAL INDUSTRIES	79.58	21022.65	64.46
24	FABRICATED METAL PRODUCTS	19.99	5280.76	16.19
25	MACHINERY (NONELECTRICAL)	5.09	1344.63	4.12
26	ELECT. & TRANSPORT EQUIP.	11.20	2958.70	9.07
27	MISCELLANEOUS MANUFACTURING	0.00	0.00	0.00
28	ELECTRICITY	879.14	232242.41	712.10
29	WATER SUPPLY	19.56	5167.17	15.84
30	CONSTRUCTION	749.81	198077.31	607.35
31	DISTRIBUTION	813.36	214865.31	658.82
32	TRANSPORT & COMMUNICATION	2035.12	537617.65	1648.45
33	FINANCE & BUSINESS SERVS.	1401.71	370289.73	1135.39
34	HEALTH & EDUCATION	4581.50	1210294.86	3711.02
35	OTHER SERVICES	18982.47	5014599.10	15375.80
	TOTAL INTERMEDIATE DEMAND	855789.34	226073869.96	693189.36
	FINAL DEMAND:			
36	HOUSEHOLD CONSUMPTION	24829.88	6559309.40	20112.20
37	GOVERNMENT CONSUMPTION	13383.71	3535574.67	10840.81
38	TOURISTS CONSUMPTION	2178.69	575544.54	1764.74
39	OTHER FINAL DEMAND[a]	0.00	0.00	0.00
	TOTAL FINAL DEMAND	40392.28	10670428.61	32717.75
	TOTAL OUTPUT	896181.62	236744298.57	725907.11

Note: [a] Includes Fixed Capital Formation, Net Changes in Stocks, and Exports.

about 820.3 million cubic meters (or 664.5 thousand acre-feet). That is, the agricultural direct demand of water grows, on average, at about 4.3 percent per year over the period of 1990-1995. On the other hand, the industrial sector direct demand for water, excluding agriculture, is expected to amount to 35.4 million cubic meters (or 28.7 thousand acre-feet) in 1995, i.e., an average increase of about 5.1 percent per annum between the years 1990 and 1995. The direct water requirements by the sectors of final demand is estimated to be equal to 40.4 million cubic meters (or 32.7 thousand acre-feet) in the year 1995, of which the household direct demand of water will comprise about 24.8 million cubic meters (or 20.1 thousand acre-feet) (see Table 7.14).

Under the first scenario of growth, the estimated patterns of water allocation among different sectors of the economy of Jordan are presented in Table 7.15 for the year 2000. As Table 7.15 shows, the total intermediate demand for water is estimated to be about 1401.5 million cubic meters (or 1137.6 thousand acre-feet), of which the agriculture sector has the highest direct water use among other sectors. Its direct demand of water is expected to reach about 1350.8 million cubic meters (or 1094.1 thousand acre-feet). The agricultural direct demand of water grows on average at about 6.1 percent per year over the period of 1995-2000. On the other hand, in the year 2000, the industrial sector's direct demand for water, excluding agriculture, is expected to amount

Table 7.15: Patterns of Allocation of Water Output Estimated for Intermediate and Final Demand Sectors, Jordan, 2000 (First Growth Scenario)

	Sector Name	Water Requirements (Thousand CM)	Water Requirements (Thousand Gallons)	Water Requirements (Acre-feet)
		1	2	3
	INTERMEDIATE DEMAND:			
1	AGRICULTURE	1350769.23	356832707.49	1094123.08
2	FERTILIZER MINERAL MINING	42.95	11346.10	34.79
3	OTHER MINING & CRUDE OIL	0.00	0.00	0.00
4	GRAIN MILL PRODUCTS	30.90	8162.85	25.03
5	BAKERY PRODUCTS	1892.75	500007.77	1533.13
6	CONFECTIONERY	288.20	76133.79	233.44
7	OTHER FOOD MANUFACTURE	539.69	142569.91	437.15
8	PREPARED ANIMAL FOOD	19.38	5119.61	15.70
9	BEVERAGES	3251.07	858835.16	2633.37
10	TOBACCO	96.30	25439.57	78.00
11	TEXTILE MANUFACTURE	21.46	5669.09	17.38
12	WEARING APPAREL	10.83	2860.96	8.77
13	LEATHER & FOOTWEAR	0.00	0.00	0.00
14	WOOD, CORK & FURNITURE	180.08	47571.73	145.86
15	PAPER & PAPER PRODUCTS	118.01	31174.70	95.59
16	PRINTING & PUBLISHING	20.79	5492.09	16.84
17	IND. & OTHER CHEMICALS	503.28	132951.48	407.66
18	PETROLEUM REFINERY	63.67	16819.70	51.57
19	RUBBER & PLASTIC	237.97	62864.53	192.76
20	POTTERY & GLASS	31.34	8279.09	25.39
21	CEMENT, LIME & PLASTER	226.87	59932.25	183.76
22	OTHER NONMETAL MIN. PRODS.	1529.22	403974.05	1238.67
23	BASIC METAL INDUSTRIES	89.14	23548.11	72.20
24	FABRICATED METAL PRODUCTS	26.58	7021.64	21.53
25	MACHINERY (NONELECTRICAL)	6.60	1743.52	5.35
26	ELECT. & TRANSPORT EQUIP.	16.00	4226.72	12.96
27	MISCELLANEOUS MANUFACTURING	0.00	0.00	0.00
28	ELECTRICITY	1399.03	369581.76	1133.21
29	WATER SUPPLY	32.03	8461.37	25.94
30	CONSTRUCTION	781.99	206578.30	633.41
31	DISTRIBUTION	1293.40	341677.48	1047.65
32	TRANSPORT & COMMUNICATION	3096.24	817933.72	2507.95
33	FINANCE & BUSINESS SERVS.	2101.51	555155.90	1702.22
34	HEALTH & EDUCATION	7847.90	2073179.74	6356.80
35	OTHER SERVICES	27894.87	7368987.81	22594.84
	TOTAL INTERMEDIATE DEMAND	1404459.28	371016007.99	1137612.00
	FINAL DEMAND:			
36	HOUSEHOLD CONSUMPTION	42849.61	11319581.47	34708.18
37	GOVERNMENT CONSUMPTION	17575.03	4642795.68	14235.77
38	TOURISTS CONSUMPTION	2780.62	734556.39	2252.30
39	OTHER FINAL DEMAND[a]	0.00	0.00	0.00
	TOTAL FINAL DEMAND	63205.26	16696933.54	51196.25
	TOTAL OUTPUT	1467664.54	387712941.53	1188808.25

Note: [a] Includes Fixed Capital Formation, Net Changes in Stocks, and Exports.

to 53.7 million cubic meters (or 43.5 thousand acre-feet), (an average increase of about 6.2 percent per annum between the years 1995 and 2000). The direct water requirements by the sectors of final demand are estimated to be equal to 63.2 million cubic meters (or 51.2 thousand acre-feet) in the year 2000, of which the household direct demand of water will comprise about 42.8 million cubic meters (or 34.7 thousand acre-feet) (see Table 7.15).

Under the second scenario of growth the estimated patterns of water allocation among different sectors of the economy of Jordan is presented in Table 7.16 for the year 2000. Table 7.16 shows the total intermediate demand for water is estimated to be about 1046.2 million cubic meters (or 847.4 thousand acre-feet), of which the agriculture sector has the highest direct water use among other sectors. Its direct demand of water is expected to reach about 1000.5 million cubic meters (or 810.4 thousand acre-feet). That is, the agricultural direct demand of water grows on average at about 4.0 percent per year over the period of 1995-2000. On the other hand, in the year 2000, the industrial sector's direct demand for water, excluding agriculture, is expected to amount to 45.7 million cubic meters (or 37.0 thousand acre-feet). That is, an average decrease of about 3.2 percent per annum between the years 1995 and 2000. The direct water requirements by the sectors of final demand is estimated to be equal to 49.1 million cubic meters (or 39.8 thousand acre-feet) in

Table 7.16: Patterns of Allocation of Water Output Estimated for Intermediate and Final Demand Sectors, Jordan, 2000 (Second Growth Scenario)

	Sector Name	Water Requirements (Thousand CM)	Water Requirements (Thousand Gallons)	Water Requirements (Acre-feet)
		1	2	3
	INTERMEDIATE DEMAND:			
1	AGRICULTURE	1000468.70	264293816.48	810379.65
2	FERTILIZER MINERAL MINING	41.65	11002.68	33.74
3	OTHER MINING & CRUDE OIL	0.00	0.00	0.00
4	GRAIN MILL PRODUCTS	21.98	5806.46	17.80
5	BAKERY PRODUCTS	1305.17	344786.76	1057.19
6	CONFECTIONERY	211.88	55972.34	171.62
7	OTHER FOOD MANUFACTURE	378.19	99906.45	306.33
8	PREPARED ANIMAL FOOD	14.70	3883.30	11.91
9	BEVERAGES	2277.64	601684.16	1844.89
10	TOBACCO	68.98	18222.45	55.87
11	TEXTILE MANUFACTURE	15.70	4147.47	12.72
12	WEARING APPAREL	7.84	2071.09	6.35
13	LEATHER & FOOTWEAR	0.00	0.00	0.00
14	WOOD, CORK & FURNITURE	130.31	34423.99	105.55
15	PAPER & PAPER PRODUCTS	93.06	24583.66	75.38
16	PRINTING & PUBLISHING	15.97	4218.79	12.94
17	IND. & OTHER CHEMICALS	390.74	103221.79	316.50
18	PETROLEUM REFINERY	52.95	13987.80	42.89
19	RUBBER & PLASTIC	209.22	55269.65	169.47
20	POTTERY & GLASS	25.23	6665.01	20.44
21	CEMENT, LIME & PLASTER	211.08	55761.00	170.97
22	OTHER NONMETAL MIN. PRODS.	1477.62	390342.88	1196.87
23	BASIC METAL INDUSTRIES	84.54	22332.93	68.48
24	FABRICATED METAL PRODUCTS	22.28	5885.71	18.05
25	MACHINERY (NONELECTRICAL)	5.74	1516.34	4.65
26	ELECT. & TRANSPORT EQUIP.	13.06	3450.06	10.58
27	MISCELLANEOUS MANUFACTURING	0.00	0.00	0.00
28	ELECTRICITY	1085.41	286732.76	879.18
29	WATER SUPPLY	23.90	6313.66	19.36
30	CONSTRUCTION	762.73	201490.38	617.81
31	DISTRIBUTION	1006.50	265887.11	815.27
32	TRANSPORT & COMMUNICATION	2698.65	712902.37	2185.91
33	FINANCE & BUSINESS SERVS.	1907.10	503798.61	1544.75
34	HEALTH & EDUCATION	5330.60	1408184.60	4317.79
35	OTHER SERVICES	25835.96	6825085.55	20927.13
	TOTAL INTERMEDIATE DEMAND	1046195.08	276373354.29	847418.04
	FINAL DEMAND:			
36	HOUSEHOLD CONSUMPTION	28784.64	7604038.35	23315.56
37	GOVERNMENT CONSUMPTION	17575.03	4642795.68	14235.77
38	TOURISTS CONSUMPTION	2780.62	734556.39	2252.30
39	OTHER FINAL DEMAND[a]	0.00	0.00	0.00
	TOTAL FINAL DEMAND	49140.29	12981390.42	39803.63
	TOTAL OUTPUT	1095335.37	289354744.60	887221.67

Note: [a] Includes Fixed Capital Formation, Net Changes in Stocks, and Exports.

the year 2000, of which the household direct demand of water will comprise about 28.8 million cubic meters (or 23.3 thousand acre-feet) (see Table 7.16).

7.2.3.2 The Projected Total Water Requirements

The total water requirements or demand for water are estimated for the years 1990, 1995, and 2000. These projections are based on the assumptions of constant technical coefficients of production; i.e., a_{ij}, and the new level of final demand sector projected for each sector for each of those years.

Using the first scenario of growth, Table 7.17 presents the total requirements of water by each sector needed to satisfy the estimated final demand in the year 1990. It shows that the total water requirements needed by each sector of the estimated final demand as well as that needed for the total final demand. For example, if the estimated total final demand for the output of the agricultural sector amounts to JD 311.9 million in the year 1990 (see Table 7.5), then the total water output needed, directly and indirectly, throughout the economy is estimated to be 438.8 million cubic meters. In other words, should the final demand for the agricultural sector increase to JD 311.9 million in the year 1990, then the total water requirements needed to support that total of final demand would be 438.8 million cubic meters. Much of the total requirements of water by the agricultural sector are

Table 7.17: Total Water Requirements for The Estimated Total Final Demand by Sector, Jordan, 1990
(Cubic Meters)
(First Growth Scenario)

	SECTOR NAME	HOUSEHOLD CONSUMPTION	GOVERNMENT CONSUMPTION	EXPORTS	TOURISTS CONSUMPTION	OTHER FINAL DEMAND[a]	TOTAL FINAL DEMAND
		1	2	3	4	5	6
1	AGRICULTURE	325851838.73	13236596.13	80604448.99	14204339.58	4924831.45	438822054.88
2	FERTILIZER MINERAL MINING	4460.50	0.00	1129128.63	0.00	0.00	1133589.13
3	OTHER MINING & CRUDE OIL	18.66	6.00	27.04	0.00	-260.66	-208.96
4	GRAIN MILL PRODUCTS	15426977.71	1040691.25	311939.99	1254824.56	0.00	18034433.51
5	BAKERY PRODUCTS	49231190.62	287967.43	367137.44	2124941.35	0.00	52011236.84
6	CONFECTIONERY	3763841.22	87769.41	224926.25	569331.13	0.00	4645868.01
7	OTHER FOOD MANUFACTURE	184325112.35	2026277.67	4628276.90	9282376.99	-27427.72	200234616.19
8	PREPARED ANIMAL FOOD	228272.80	0.00	119117.28	0.00	1982781.04	2330171.12
9	BEVERAGES	4561321.53	140366.84	84050.44	248157.36	-57832.50	4976063.67
10	TOBACCO	16088602.81	0.00	1638577.60	523541.28	7269.80	18257991.49
11	TEXTILE MANUFACTURE	1089562.98	63492.76	94833.90	3486.07	4953.83	1256329.54
12	WEARING APPAREL	208780.65	13177.96	19752.48	1349.60	-2350.80	240709.89
13	LEATHER & FOOTWEAR	560289.09	29417.64	15308.21	1438.76	-741.93	605711.77
14	WOOD, CORK & FURNITURE	132728.23	169.76	14497.16	533.30	1434.00	149362.45
15	PAPER & PAPER PRODUCTS	21792.81	12189.99	20425.73	6512.17	-3701.22	57219.48
16	PRINTING & PUBLISHING	37193.52	2203.22	837.19	5883.31	0.00	46117.24
17	IND. & OTHER CHEMICALS	612509.53	12583.88	194799.50	8757.59	-3036.56	825613.94
18	PETROLEUM REFINERY	52724.21	4949.65	70.42	17516.21	1512.00	76772.49
19	RUBBER & PLASTIC	22377.84	5647.19	59110.34	5108.89	16985.01	109229.27
20	POTTERY & GLASS	22047.76	75.72	1966.89	33.39	0.00	24123.76
21	CEMENT, LIME & PLASTER	22843.62	4558.10	1438.71	0.00	10902.60	39743.03
22	OTHER NONMETAL MIN. PRODS.	0.00	4962.59	242748.56	0.00	65267.54	312978.69
23	BASIC METAL INDUSTRIES	0.00	790.51	3319.43	0.00	6067.32	10177.26
24	FABRICATED METAL PRODUCTS	44547.09	2047.05	6225.21	277.78	57862.35	110959.48
25	MACHINERY (NONELECTRICAL)	24031.54	10734.39	852.62	29.36	42925.49	78573.4
26	ELECT. & TRANSPORT EQUIP.	26356.12	6472.50	562.31	1358.20	17155.04	51904.17
27	MISCELLANEOUS MANUFACTURING	7396.45	350.34	267.09	962.90	0.00	8976.78
28	ELECTRICITY	551299.83	49928.80	0.00	19114.12	0.00	620342.75
29	WATER SUPPLY	24386295.92	10193246.61	0.00	1707278.85	0.00	36286821.38
30	CONSTRUCTION	77682.03	18226.05	0.00	0.00	2299952.17	2395860.25
31	DISTRIBUTION	0.00	0.00	41987.79	0.00	-14046.90	27940.89
32	TRANSPORT & COMMUNICATION	3868747.76	934410.73	3324885.48	1133576.79	0.00	9261620.76
33	FINANCE & BUSINESS SERVS.	134368.24	45148.28	700089.86	101290.29	0.00	980896.67
34	HEALTH & EDUCATION	11289932.88	10502.57	0.00	217733.46	0.00	11518168.91
35	OTHER SERVICES	2798480.83	93498.27	6714637.09	2948259.77	0.00	12554875.96
	TOTAL	645473625.86	28338459.29	100566246.53	34388013.06	9330501.35	818096846.09

Note: [a] Contains Fixed Capital Formation, and Net Change in Stocks. It is assumed that they remain constant as in the base year.

attributed to the household consumption of agricultural products, where the amount of water needed to satisfy the household consumption of agricultural products amounts to 325.9 million cubic meters (see Table 7.17).

Also in the industrial sector significant amounts of water are needed directly and indirectly to satisfy the estimated total final demand by such sectors as Other Food Manufacture, Bakery Products, Tobacco, and Grain Mill Products. These amounts are, respectively, 200.2 million cubic meters; 52.0 million cubic meters; 18.3 million cubic meters; and 18.0 million cubic meters (see Table 7.17).

Using the second scenario of growth Table 7.18 presents the total requirements of water by each sector needed to satisfy the estimated final demand in the year 1990. It shows that the total water requirements needed by each sector of the estimated final demand as well as that needed for the total final demand. For example, if the estimated total final demand for the output of the Agricultural sector amounts to JD 278.8 million in the year 1990 (see Table 7.6), then the total water output needed, directly and indirectly, throughout the economy is estimated to be 392.4 million cubic meters. In other words, should the final demand for the Agricultural sector increase to JD 278.8 million in the year 1990, then the total water requirements needed to support that total of final demand would be 392.4 million cubic meters. Much of the total requirements of water by the Agricultural sector are

Table 7.18: Total Water Requirements for The Estimated Total Final Demand by Sector, Jordan, 1990
(Cubic Meters)
(Second Growth Scenario)

	SECTOR NAME	HOUSEHOLD CONSUMPTION	GOVERNMENT CONSUMPTION	EXPORTS	TOURISTS CONSUMPTION	OTHER FINAL DEMAND[a]	TOTAL FINAL DEMAND
		1	2	3	4	5	6
1	AGRICULTURE	279384914.26	13236596.13	80604448.99	14204339.58	4924831.45	392355130.41
2	FERTILIZER MINERAL MINING	3824.50	0.00	1129128.63	0.00	0.00	1132953.13
3	OTHER MINING & CRUDE OIL	16.00	6.00	27.04	0.00	-260.66	-211.62
4	GRAIN MILL PRODUCTS	13227073.21	1040691.25	311939.99	1254824.56	0.00	15834529.01
5	BAKERY PRODUCTS	42210754.33	287967.43	367137.44	2124941.35	0.00	44990800.55
6	CONFECTIONERY	3227111.97	87769.41	224926.25	569331.13	0.00	4109138.76
7	OTHER FOOD MANUFACTURE	158040092.88	2026277.67	4628276.90	9282376.99	-27427.72	173949596.72
8	PREPARED ANIMAL FOOD	195721.00	0.00	119117.28	0.00	1982781.04	2297619.32
9	BEVERAGES	3910872.00	140366.84	84050.44	248157.36	-57832.50	4325614.14
10	TOBACCO	13794345.91	0.00	1638577.60	523541.28	7269.80	15963734.59
11	TEXTILE MANUFACTURE	934189.72	63492.76	94833.90	3486.07	4953.83	1100956.28
12	WEARING APPAREL	179008.26	13177.96	19752.48	1349.60	-2350.80	210937.5
13	LEATHER & FOOTWEAR	480391.12	29417.64	15308.21	1438.76	-741.93	525813.8
14	WOOD, CORK & FURNITURE	113800.99	169.76	14497.16	533.30	1434.00	130435.21
15	PAPER & PAPER PRODUCTS	18685.10	12189.99	20425.73	6512.17	-3701.22	54111.77
16	PRINTING & PUBLISHING	31889.65	2203.22	837.19	5883.31	0.00	40813.37
17	IND. & OTHER CHEMICALS	525164.78	12583.88	194799.50	8757.59	-3036.56	738269.19
18	PETROLEUM REFINERY	45205.66	4949.65	70.42	17516.21	1512.00	69253.94
19	RUBBER & PLASTIC	19186.75	5647.19	59110.34	5108.89	16985.01	106038.18
20	POTTERY & GLASS	18903.72	75.72	1966.89	33.39	0.00	20979.72
21	CEMENT, LIME & PLASTER	19586.08	4558.10	1438.71	0.00	10902.60	36485.49
22	OTHER NONMETAL MIN. PRODS.	0.00	4962.59	242748.56	0.00	65267.54	312978.69
23	BASIC METAL INDUSTRIES	0.00	790.51	3319.43	0.00	6067.32	10177.26
24	FABRICATED METAL PRODUCTS	38194.61	2047.05	6225.21	277.78	57862.35	104607
25	MACHINERY (NONELECTRICAL)	20604.61	10734.39	852.62	29.36	42925.49	75146.47
26	ELECT. & TRANSPORT EQUIP.	22597.70	6472.50	562.31	1358.20	17155.04	48145.75
27	MISCELLANEOUS MANUFACTURING	6341.71	350.34	267.09	962.90	0.00	7922.04
28	ELECTRICITY	472683.81	49928.80	0.00	19114.12	0.00	541726.73
29	WATER SUPPLY	20908770.16	10193246.61	0.00	1707278.85	0.00	32809295.62
30	CONSTRUCTION	66604.47	18226.05	0.00	0.00	2299952.17	2384782.69
31	DISTRIBUTION	0.00	0.00	41987.79	0.00	-14046.90	27940.89
32	TRANSPORT & COMMUNICATION	3317058.93	934410.73	3324885.48	1133576.79	0.00	8709931.93
33	FINANCE & BUSINESS SERVS.	115207.15	45148.28	700089.86	101290.29	0.00	961735.58
34	HEALTH & EDUCATION	9679972.60	10502.57	0.00	217733.46	0.00	9908208.63
35	OTHER SERVICES	2399413.46	93498.27	6714637.09	2948259.77	0.00	12155808.59
	TOTAL	553428187.10	28338459.29	100566246.53	34388013.06	9330501.35	726051407.33

Note: [a] Contains Fixed Capital Formation, and Net Change in Stocks. It is assumed that they remain constant as in the base year.

attributed to the household consumption of agricultural products, where the amount of water needed to satisfy the household consumption of agricultural products amounts to 279.4 million cubic meters (see Table 7.18).

Also, among the industrial sector, significant amounts of water are needed directly and indirectly to satisfy the estimated total final demand by such sectors as Other Food Manufacture, Bakery Products, Tobacco, and Grain Mill Products. These amounts are, respectively, 173.9 million cubic meters; 45.0 million cubic meters; 16.0 million cubic meters; and 15.8 million cubic meters (see Table 7.18).

Table 7.19 also shows the total requirements of water needed directly and indirectly under the first scenario of growth in order to satisfy the estimated total final demand for the year 1995. For example, if the projected total final demand for the output of the Agricultural sector amounts to JD 420.3 million in the year 1995 (see Table 7.7), then the total water output needed, directly and indirectly, throughout the economy will be 591.4 million cubic meters. In other words, should the final demand for the Agricultural sector increase to JD 420.3 million in the year 1995, then the total water requirements needed to support that new total of final demand would be 591.4 million cubic meters. However, much of the total requirements to satisfy the total final demand for Agricultural sector are attributed to the household final demand for the agricultural output, where its total

Table 7.19: Total Water Requirements for the Estimated Total Final Demand by Sector, Jordan, 1995
(Cubic Meters)
(First Growth Scenario)

	SECTOR NAME	HOUSEHOLD CONSUMPTION	GOVERNMENT CONSUMPTION	EXPORTS	TOURISTS CONSUMPTION	OTHER FINAL DEMAND[a]	TOTAL FINAL DEMAND
		1	2	3	4	5	6
1	AGRICULTURE	431964958.78	17381840.83	118983702.70	18128740.77	4924831.45	591384074.53
2	FERTILIZER MINERAL MINING	5913.03	0.00	1666755.47	0.00	0.00	1672668.5
3	OTHER MINING & CRUDE OIL	24.74	7.88	39.92	0.00	-260.66	-188.12
4	GRAIN MILL PRODUCTS	20450751.13	1366598.60	460465.42	1601510.55	0.00	23879325.7
5	BAKERY PRODUCTS	65263249.88	378151.48	541945.91	2712019.74	0.00	68895367.01
6	CONFECTIONERY	4989530.05	115254.34	332022.15	726627.43	0.00	6163433.97
7	OTHER FOOD MANUFACTURE	244350279.87	2660838.54	6831998.20	11846923.67	-27427.72	265662612.56
8	PREPARED ANIMAL FOOD	302606.57	0.00	175831.66	0.00	1982781.04	2461219.27
9	BEVERAGES	6046707.87	184324.33	124069.89	316719.23	-57832.50	6613988.82
10	TOBACCO	21327830.88	0.00	2418775.08	668186.04	7269.80	24422061.8
11	TEXTILE MANUFACTURE	1444377.39	83376.51	139988.31	4449.25	4953.83	1677145.29
12	WEARING APPAREL	276769.73	17304.85	29157.50	1722.46	-2350.80	322603.74
13	LEATHER & FOOTWEAR	742746.28	38630.35	22597.06	1836.27	-741.93	805068.03
14	WOOD, CORK & FURNITURE	175950.96	222.93	21399.87	680.65	1434.00	199688.41
15	PAPER & PAPER PRODUCTS	28889.60	16007.45	30151.31	8311.35	-3701.22	79658.49
16	PRINTING & PUBLISHING	49305.52	2893.20	1235.81	7508.76	0.00	60943.29
17	IND. & OTHER CHEMICALS	811972.27	16524.73	287551.91	11177.12	-3036.56	1124189.47
18	PETROLEUM REFINERY	69893.76	6499.70	103.95	22355.62	1512.00	100365.03
19	RUBBER & PLASTIC	29665.15	7415.68	87255.34	6520.36	16985.01	147841.54
20	POTTERY & GLASS	29227.58	99.43	2903.41	42.62	0.00	32273.04
21	CEMENT, LIME & PLASTER	30282.63	5985.53	2123.72	0.00	10902.60	49294.48
22	OTHER NONMETAL MIN. PRODS.	0.00	6516.71	358331.60	0.00	65267.54	430115.85
23	BASIC METAL INDUSTRIES	0.00	1038.07	4899.97	0.00	6067.32	12005.36
24	FABRICATED METAL PRODUCTS	59053.78	2688.11	9189.30	354.52	57862.35	129148.06
25	MACHINERY (NONELECTRICAL)	31857.38	14096.03	1258.59	37.48	42925.49	90174.97
26	ELECT. & TRANSPORT EQUIP.	34938.94	8499.46	830.05	1733.44	17155.04	63156.93
27	MISCELLANEOUS MANUFACTURING	9805.09	460.05	394.26	1228.93	0.00	11888.33
28	ELECTRICITY	730829.68	65564.78	0.00	24395.01	0.00	820789.47
29	WATER SUPPLY	32327653.87	13385425.79	0.00	2178969.31	0.00	47892048.97
30	CONSTRUCTION	102979.09	23933.83	0.00	0.00	2299952.17	2426865.09
31	DISTRIBUTION	0.00	0.00	61979.97	0.00	-14046.90	47933.07
32	TRANSPORT & COMMUNICATION	5128599.16	1227036.27	4908006.86	1446763.14	0.00	12710405.43
33	FINANCE & BUSINESS SERVS.	178125.06	59287.19	1033432.87	129274.89	0.00	1400120.01
34	HEALTH & EDUCATION	14966481.03	13791.54	0.00	277889.11	0.00	15258161.68
35	OTHER SERVICES	3709801.43	122778.89	9911765.51	3762809.48	0.00	17507155.31
	TOTAL	855671058.18	37213093.08	148450163.57	43888787.20	9330501.35	1094553603.38

Note: [a] Contains Fixed Capital Formation, and Net Change in Stocks. It is assumed that they remain constant as in the base year.

requirements of water to satisfy its final demand are 432.0 million cubic meters (see Table 7.19).

However, if we look at the industrial sector on a disaggregate level, we could see, for example, that the total water requirements to satisfy the total final demand of the sectors of Other Food Manufacture, Bakery Products, Tobacco, and Grain Mill Products are, respectively, 265.7 million cubic meters; 68.9 million cubic meters; 24.4 million cubic meters; and 23.9 million cubic meters (see Table 7.19).

Table 7.20 shows also the total requirements of water needed directly and indirectly under the second scenario of growth in order to satisfy the estimated total final demand for the year 1995. For example, if the estimated total final demand for the output of the Agricultural sector amounts to JD 349.1 million in the year 1995 (see Table 7.8), then the total water output needed, directly and indirectly, throughout the economy will be 491.2 million cubic meters. In other words, should the final demand for the Agricultural sector increases to JD 349.1 million in the year 1995, then the total water requirements needed to support that new total of final demand would be 491.2 million cubic meters. However, much of that total requirements to satisfy the total final demand for Agricultural sector are attributed to the household final demand for the agricultural output, where its total requirements of water to satisfy its final demand are 331.8 million cubic meters (see Table 7.20).

Table 7.20: Total Water Requirements for The Estimated Total Final Demand by Sector, Jordan, 1995
(Cubic Meters)
(Second Growth Scenario)

	SECTOR NAME	HOUSEHOLD CONSUMPTION	GOVERNMENT CONSUMPTION	EXPORTS	TOURISTS CONSUMPTION	OTHER FINAL DEMAND[a]	TOTAL FINAL DEMAND
		1	2	3	4	5	6
1	AGRICULTURE	331821634.99	17381840.83	118983702.70	18128740.77	4924831.45	491240750.74
2	FERTILIZER MINERAL MINING	4542.27	0.00	1666755.47	0.00	0.00	1671297.74
3	OTHER MINING & CRUDE OIL	19.00	7.88	39.92	0.00	-260.66	-193.86
4	GRAIN MILL PRODUCTS	15709610.88	1366598.60	460465.42	1601510.55	0.00	19138185.45
5	BAKERY PRODUCTS	50133136.28	378151.48	541945.91	2712019.74	0.00	53765253.41
6	CONFECTIONERY	3832797.43	115254.34	332022.15	726627.43	0.00	5006701.35
7	OTHER FOOD MANUFACTURE	187702054.38	2660838.54	6831998.20	11846923.67	-27427.72	209014387.07
8	PREPARED ANIMAL FOOD	232457.15	0.00	175831.66	0.00	1982781.04	2391069.85
9	BEVERAGES	4644889.50	184324.33	124069.89	316719.23	-57832.50	5212170.45
10	TOBACCO	16383355.44	0.00	2418775.08	668186.04	7269.80	19477586.36
11	TEXTILE MANUFACTURE	1109524.36	83376.51	139988.31	4449.25	4953.83	1342292.26
12	WEARING APPAREL	212605.65	17304.85	29157.50	1722.46	-2350.80	258439.66
13	LEATHER & FOOTWEAR	570553.91	38630.35	22597.06	1836.27	-741.93	632875.66
14	WOOD, CORK & FURNITURE	135159.88	222.93	21399.87	680.65	1434.00	158897.33
15	PAPER & PAPER PRODUCTS	22192.04	16007.45	30151.31	8311.35	-3701.22	72960.93
16	PRINTING & PUBLISHING	37874.91	2893.20	1235.81	7508.76	0.00	49512.68
17	IND. & OTHER CHEMICALS	623730.98	16524.73	287551.91	11177.12	-3036.56	935948.18
18	PETROLEUM REFINERY	53690.14	6499.70	103.95	22355.62	1512.00	84161.41
19	RUBBER & PLASTIC	22787.83	7415.68	87255.34	6520.36	16985.01	140964.22
20	POTTERY & GLASS	22451.70	99.43	2903.41	42.62	0.00	25497.16
21	CEMENT, LIME & PLASTER	23262.11	5985.53	2123.72	0.00	10902.60	42273.96
22	OTHER NONMETAL MIN. PRODS.	0.00	6516.71	358331.60	0.00	65267.54	430115.85
23	BASIC METAL INDUSTRIES	0.00	1038.07	4899.97	0.00	6067.32	12005.36
24	FABRICATED METAL PRODUCTS	45363.22	2688.11	9189.30	354.52	57862.35	115457.5
25	MACHINERY (NONELECTRICAL)	24471.82	14096.03	1258.59	37.48	42925.49	82789.41
26	ELECT. & TRANSPORT EQUIP.	26838.98	8499.46	830.05	1733.44	17155.04	55056.97
27	MISCELLANEOUS MANUFACTURING	7531.95	460.05	394.26	1228.93	0.00	9615.19
28	ELECTRICITY	561400.14	65564.78	0.00	24395.01	0.00	651359.93
29	WATER SUPPLY	24833063.19	13385425.79	0.00	2178969.31	0.00	40397458.29
30	CONSTRUCTION	79105.23	23933.83	0.00	0.00	2299952.17	2402991.23
31	DISTRIBUTION	0.00	0.00	61979.97	0.00	-14046.90	47933.07
32	TRANSPORT & COMMUNICATION	3939625.44	1227036.27	4908006.86	1446763.14	0.00	11521431.71
33	FINANCE & BUSINESS SERVS.	136829.95	59287.19	1033432.87	129274.89	0.00	1358824.9
34	HEALTH & EDUCATION	11496770.82	13791.54	0.00	277889.11	0.00	11788451.47
35	OTHER SERVICES	2849750.60	122778.89	9911765.51	3762809.48	0.00	16647104.48
	TOTAL	657299082.17	37213093.08	148450163.57	43888787.20	9330501.35	896181627.37

Note: [a] Contains Fixed Capital Formation, and Net Change in Stocks. It is assumed that they remain constant as in the base year.

However, if we look at the industrial sector on a disaggregate level, we could see, for example, that the total water requirements to satisfy the total final demand of the sectors of Other Food Manufacture, Bakery Products, Tobacco, and Grain Mill Products are, respectively, 209.0 million cubic meters; 53.8 million cubic meters; 19.5 million cubic meters; and 19.1 million cubic meters (see Table 7.20).

Table 7.21 also shows, based on the first scenario of growth, the total requirements of water needed directly and indirectly in order to satisfy the estimated total final demand for the year 2000. For example, if the estimated total final demand for the output of the Agricultural sector amounts to JD 567.9 million in the year 2000 (see Table 7.9), then the total water output needed, directly and indirectly, throughout the economy will be 799.2 million cubic meters. In other words, should the final demand for the Agricultural sector increase to JD 567.9 million in the year 2000, then the total water requirements needed to support that new total of final demand would be 799.2 million cubic meters. However, much of that total requirements of water to satisfy the total final demand for Agricultural sector are attributed to the household final demand for the agricultural output, where its total requirements of water to satisfy its final demand are 572.6 million cubic meters (see Table 7.21).

However, if we look at the industrial sector on a disaggregate level, we could see, for example, that the total

Table 7.21: Total Water Requirements for the Estimated Total Final Demand by Sector, Jordan, 2000
(Cubic Meters)
(First Growth Scenario)

	SECTOR NAME	HOUSEHOLD CONSUMPTION	GOVERNMENT CONSUMPTION	EXPORTS	TOURISTS CONSUMPTION	OTHER FINAL DEMAND[a]	TOTAL FINAL DEMAND
		1	2	3	4	5	6
1	AGRICULTURE	572633637.10	22825242.96	175636979.69	23137378.78	4924831.45	799158069.98
2	FERTILIZER MINERAL MINING	7838.57	0.00	2460369.68	0.00	0.00	2468208.25
3	OTHER MINING & CRUDE OIL	32.79	10.35	58.93	0.00	-260.66	-158.59
4	GRAIN MILL PRODUCTS	27110506.67	1794569.68	679714.23	2043976.72	0.00	31628767.3
5	BAKERY PRODUCTS	86516118.91	496578.73	799986.87	3461298.32	0.00	91273982.83
6	CONFECTIONERY	6614360.88	151347.24	490112.30	927381.23	0.00	8183201.65
7	OTHER FOOD MANUFACTURE	323922545.74	3494120.10	10085008.08	15120010.64	-27427.72	352594256.84
8	PREPARED ANIMAL FOOD	401150.79	0.00	259552.88	0.00	1982781.04	2643484.71
9	BEVERAGES	8015808.80	242048.20	183145.32	404223.65	-57832.50	8787393.47
10	TOBACCO	28273205.29	0.00	3570459.27	852793.15	7269.80	32703727.51
11	TEXTILE MANUFACTURE	1914736.54	109487.28	206642.84	5678.52	4953.83	2241499.01
12	WEARING APPAREL	366899.32	22724.12	43040.66	2198.36	-2350.80	432511.66
13	LEATHER & FOOTWEAR	984620.31	50728.02	33356.40	2343.63	-741.93	1070306.43
14	WOOD, CORK & FURNITURE	233249.11	292.75	31589.27	868.71	1434.00	267433.84
15	PAPER & PAPER PRODUCTS	38297.48	21020.42	44507.63	10607.62	-3701.22	110731.93
16	PRINTING & PUBLISHING	65361.79	3799.24	1824.23	9583.30	0.00	80568.56
17	IND. & OTHER CHEMICALS	1076389.69	21699.71	424467.74	14265.15	-3036.56	1533785.73
18	PETROLEUM REFINERY	92654.55	8535.19	153.45	28532.06	1512.00	131387.25
19	RUBBER & PLASTIC	39325.54	9737.99	128801.37	8321.82	16985.01	203171.73
20	POTTERY & GLASS	38745.50	130.57	4285.85	54.40	0.00	43216.32
21	CEMENT, LIME & PLASTER	40144.14	7860.01	3134.93	0.00	10902.60	62041.68
22	OTHER NONMETAL MIN. PRODS.	0.00	8557.58	528948.73	0.00	65267.54	602773.85
23	BASIC METAL INDUSTRIES	0.00	1363.16	7233.05	0.00	6067.32	14663.53
24	FABRICATED METAL PRODUCTS	78284.55	3529.94	13564.73	452.47	57862.35	153694.04
25	MACHINERY (NONELECTRICAL)	42231.68	18510.43	1857.86	47.83	42925.49	105573.29
26	ELECT. & TRANSPORT EQUIP.	46316.75	11161.21	1225.27	2212.36	17155.04	78070.63
27	MISCELLANEOUS MANUFACTURING	12998.10	604.12	581.99	1568.46	0.00	15752.67
28	ELECTRICITY	968823.14	86097.39	0.00	31134.90	0.00	1086055.43
29	WATER SUPPLY	42855103.32	17577283.12	0.00	2780976.48	0.00	63213362.92
30	CONSTRUCTION	136514.04	31429.08	0.00	0.00	2299952.17	2467895.29
31	DISTRIBUTION	0.00	0.00	91491.31	0.00	-14046.90	77444.41
32	TRANSPORT & COMMUNICATION	6798719.09	1611302.12	7244920.64	1846477.16	0.00	17501419.01
33	FINANCE & BUSINESS SERVS.	236131.20	77853.96	1525494.81	164991.21	0.00	2004471.18
34	HEALTH & EDUCATION	19840290.86	18110.64	0.00	354664.74	0.00	20213066.24
35	OTHER SERVICES	4917892.03	161229.06	14631184.59	4802404.21	0.00	24512709.89
	TOTAL	1134318934.27	48866964.37	219133694.60	56014445.88	9330501.35	1467664540.47

Note: [a] Contains Fixed Capital Formation, and Net Change in Stocks. It is assumed that they remain constant as in the base year.

water requirements to satisfy the total final demand of the sectors such as Other Food Manufacture, Bakery Products, Tobacco, and Grain Mill Products are, respectively, 352.6 million cubic meters; 91.3 million cubic meters; 32.7 million cubic meters; and 31.6 million cubic meters (see Table 7.21).

When using the second scenario of growth, Table 7.22 presents the total requirements of water needed directly and indirectly in order to satisfy the estimated total final demand for the year 2000. For example, if the projected total final demand for the output of the Agricultural sector amounts to JD 434.4 million in the year 2000 (see Table 7.10), then the total water output needed, directly and indirectly, throughout the economy will be 611.2 million cubic meters. In other words, should the final demand for the Agricultural sector increase to JD 434.4 million in the year 2000, then the total water requirements needed to support that new total of final demand would be 611.2 million cubic meters. However, much of that total requirements of water to satisfy the total final demand for Agricultural sector are attributed to the household final demand for the agricultural output, where its total requirements of water to satisfy its final demand are 384.7 million cubic meters (see Table 7.22).

However, if we look at the industrial sector on a disaggregate level, we could see, for example, that the total water requirements to satisfy the total final demand of the sectors such as Other Food Manufacture, Bakery Products,

Table 7.22: Total Water Requirements for The Estimated Total Final Demand by Sector, Jordan, 2000
(Cubic Meters)
(Second Growth Scenario)

	SECTOR NAME	HOUSEHOLD CONSUMPTION	GOVERNMENT CONSUMPTION	EXPORTS	TOURISTS CONSUMPTION	OTHER FINAL DEMAND[a]	TOTAL FINAL DEMAND
		1	2	3	4	5	6
1	AGRICULTURE	384672224.49	22825242.96	175636979.69	23137378.78	4924831.45	611196657.37
2	FERTILIZER MINERAL MINING	5265.76	0.00	2460369.68	0.00	0.00	2465635.44
3	OTHER MINING & CRUDE OIL	22.03	10.35	58.93	0.00	-260.66	-169.35
4	GRAIN MILL PRODUCTS	18211745.07	1794569.68	679714.23	2043976.72	0.00	22730005.7
5	BAKERY PRODUCTS	58118041.74	496578.73	799986.87	3461298.32	0.00	62875905.66
6	CONFECTIONERY	4443261.90	151347.24	490112.30	927381.23	0.00	6012102.67
7	OTHER FOOD MANUFACTURE	217598125.18	3494120.10	10085008.08	15120010.64	-27427.72	246269836.28
8	PREPARED ANIMAL FOOD	269480.45	0.00	259552.88	0.00	1982781.04	2511814.37
9	BEVERAGES	5384699.83	242048.20	183145.32	404223.65	-57832.50	6156284.5
10	TOBACCO	18992798.49	0.00	3570459.27	852793.15	7269.80	23423320.71
11	TEXTILE MANUFACTURE	1286242.75	109487.28	206642.84	5678.52	4953.83	1613005.22
12	WEARING APPAREL	246468.23	22724.12	43040.66	2198.36	-2350.80	312080.57
13	LEATHER & FOOTWEAR	661428.38	50728.02	33356.40	2343.63	-741.93	747114.5
14	WOOD, CORK & FURNITURE	156687.35	292.75	31589.27	868.71	1434.00	190872.08
15	PAPER & PAPER PRODUCTS	25726.64	21020.42	44507.63	10607.62	-3701.22	98161.09
16	PRINTING & PUBLISHING	43907.40	3799.24	1824.23	9583.30	0.00	59114.17
17	IND. & OTHER CHEMICALS	723075.16	21699.71	424467.74	14265.15	-3036.56	1180471.2
18	PETROLEUM REFINERY	62241.59	8535.19	153.45	28532.06	1512.00	100974.29
19	RUBBER & PLASTIC	26417.34	9737.99	128801.37	8321.82	16985.01	190263.53
20	POTTERY & GLASS	26027.67	130.57	4285.85	54.40	0.00	30498.49
21	CEMENT, LIME & PLASTER	26967.14	7860.01	3134.93	0.00	10902.60	48864.68
22	OTHER NONMETAL MIN. PRODS.	0.00	8557.58	528948.73	0.00	65267.54	602773.85
23	BASIC METAL INDUSTRIES	0.00	1363.16	7233.05	0.00	6067.32	14663.53
24	FABRICATED METAL PRODUCTS	52588.40	3529.94	13564.73	452.47	57862.35	127997.89
25	MACHINERY (NONELECTRICAL)	28369.54	18510.43	1857.86	47.83	42925.49	91711.15
26	ELECT. & TRANSPORT EQUIP.	31113.73	11161.21	1225.27	2212.36	17155.04	62867.61
27	MISCELLANEOUS MANUFACTURING	8731.60	604.12	581.99	1568.46	0.00	11486.17
28	ELECTRICITY	650816.61	86097.39	0.00	31134.90	0.00	768048.9
29	WATER SUPPLY	28788330.19	17577283.12	0.00	2780976.48	0.00	49146589.79
30	CONSTRUCTION	91704.65	31429.08	0.00	0.00	2299952.17	2423085.9
31	DISTRIBUTION	0.00	0.00	91491.31	0.00	-14046.90	77444.41
32	TRANSPORT & COMMUNICATION	4567105.68	1611302.12	7244920.64	1846477.16	0.00	15269805.6
33	FINANCE & BUSINESS SERVS.	158623.44	77853.96	1525494.81	164991.21	0.00	1926963.42
34	HEALTH & EDUCATION	13327908.29	18110.64	0.00	354664.74	0.00	13700683.67
35	OTHER SERVICES	3303641.99	161229.06	14631184.59	4802404.21	0.00	22898459.85
	TOTAL	761989788.71	48866964.37	219133694.60	56014445.88	9330501.35	1095335394.91

Note: [a] Contains Fixed Capital Formation, and Net Change in Stocks. It is assumed that they remain constant as in the base year.

Tobacco, and Grain Mill Products are, respectively, 246.3 million cubic meters; 62.9 million cubic meters; 23.4 million cubic meters; and 22.7 million cubic meters (see Table 7.22).

7.3 Summary

This chapter has examined the water situation in the economy of Jordan. It shows the allocation patterns of water among different users in the economy, i.e., intermediate and final demand sectors. For example, about 95.5 percent of water is used to satisfy the intermediate demand, whereas the sectors of the final demand uses about 4.5 percent of water.

In this study, two growth scenarios were used to estimate the total water demand in the economy of Jordan for the period 1990-2000. Under both growth scenarios, the estimates of water demand reveal that a situation of water deficit will start after the year 1990. For instance, under the first growth scenario, a water deficit of 259.55 million cubic meters will arise in the year 1995. It will reach a serious situation in the year 2000 when the estimated water deficit will be 632.66 million cubic meters. However, under the second growth scenario, the estimates of the water demand show that a situation of water deficit will begin after year 1990 but with a relatively small effect. For example, in the year 1995, the water deficit will reach 61.18 million cubic meters, then climb to 260.34 million cubic meters by the year 2000.

This alarming case, particularly in the first growth

scenario, calls for earlier planning by the decision makers on both supply and demand sides, such as harvesting all possible water resources and implementing conservation measures on all levels-- domestic, industry, and agriculture. Above all an agreement must be reached over water rights, particularly in the Jordan River basin.

Having discussed the estimated water requirements for the economy of Jordan under two alternative growth scenarios, we will discuss, in the next chapter, the policy considerations and recommendations that will conclude this dissertation.

CHAPTER 8

POLICY CONSIDERATIONS AND RECOMMENDATIONS

Jordan is a country where water resources pose a constraint to the economic growth and its development process. Thus, the question arises of how Jordan can accommodate its economic growth and development while facing constraints by the availability of its water resources.

Using input-output analysis, it is assumed that the system will be in equilibrium. That is, for a certain growth in the final demand, each sector has to produce a level of output that will meet that increase in the final demand. Therefore, if the relative prices remain unchanged, the relative tastes remain also unchanged, and the economy grows, then the water requirements for the projected growth will grow in the same proportions in order to meet the new demand. However, if there is scarcity in the water resources and the water supply system cannot grow to meet the new demand, then one way of adjusting to the new situation is by redirecting the existing resources among its users in a way that will alleviate the problem of shortages in water resources.

The above analysis presents the total demand of water by the Jordanian economy given the final demand. Table 8.1

Table 8.1: Total Water Demand and Supply in Jordan
Estimated for Selected Years, 1990-2000
(Million Cubic Meter[a])

	Year		
	1990	1995	2000
First Growth Scenario:			
Projected Demand:			
Intermediate	781.81	1046.67	1404.46
Final	36.28	47.88	63.20
Total Water Demand	818.10	1094.55	1467.66
	(662.66)	(886.59)	(1188.81)
Total Water Supply	835.00	835.00	835.00
Water Balance	+16.90	-259.55	-632.66
Second Growth Scenario:			
Projected Demand:			
Intermediate	693.25	855.79	1046.20
Final	32.80	40.39	49.14
Total Water Demand	726.05	896.18	1095.34
	(586.72)	(724.14)	(884.97)
Total Water Supply	835.00	835.00	835.00
Water Balance	+108.95	-61.18	-260.34

Note: [a] The number in parenthesis is in thousand acre-feet.

presents a summary of the results that have been calculated in the study using the two growth scenarios. In 1990, the total water demand is estimated, using the first growth scenario, at 818.10 million cubic meters (or 662.66 thousand acre-feet). Under the second scenario of growth, the total demand of water is estimated at 726.05 million cubic meter (or 586.72 thousand acre-feet) (see Table 8.1).

In 1995, under the first growth scenario, the total water demand is projected to reach about 1094.55 million cubic meters (or 886.59 thousand acre-feet). Under the second scenario of growth, the total water demand by the economy is expected to amount to 896.18 million cubic meters (or 724.14 thousand acre-feet) (see Table 8.1).

For the year 2000, the total water demand is expected to reach about 1467.66 million cubic meters (or 1188.81 thousand acre-feet) under the first scenario of growth. However, under the second scenario of growth, the total demand for water is expected to reach about 1095.34 million cubic meters (or 884.97 thousand acre-feet) (see Table 8.1).

As indicated before, planners may have expected growth rates different from those used here. In any case, the projected water demand appears reasonable.

According to estimates made by Al-Weshah (1992), the actual total water demand in Jordan in 1990 was 767 million cubic meters, whereas the projected total demand for water in Jordan in 1995 and 2000 is 1000 million cubic meters and 1120

million cubic meters, respectively. Thus our estimate of total water demand, under both growth scenarios, for the year 1990 is close to the actual number of water demand. In addition, our estimated total water demand for the year 1995 is very close to the figures given by Al-Weshah (1992). For example, under the first growth scenario, our estimated total demand for water is higher by 94 million cubic meters, and lower by 103 million cubic meters under the second growth scenario. Also for the year 2000, our estimated total water demand under the first growth scenario is higher by 347 million cubic meters, and lower by 25 million cubic meters when we consider the second growth scenario (see Table 8.1).

As shown in Chapter 4, the average annual supply of water in Jordan is estimated at 835 million cubic meters. Thus, if we assume that this supply of water will maintain at least at the same level, and using the first growth scenario, then as shown in Table 8.1, a comparison of the total demand of water with the available supply shows that there is an excess supply of water in the first phase of the plan period, i.e., 1990. In other words, had the final demand grown in 1990 in accordance with the first scenario predicted growth rates, the total water supply would have exceeded the actual total water demand by only a small margin, i.e., an excess of 16.9 million cubic meters. Thus under the first growth scenario, at least no major changes will be necessary until year 1995, when the total demand of water surpasses the total supply in 259.55

million cubic meters. Also in the year 2000, using the first growth scenario, there will be an estimated shortage of water of about 632.66 million cubic meters. However, under the second scenario of growth, a comparison of total demand and total supply of water reveals that the total supply exceeds the total demand only in the year 1990, when it reaches about 108.95 million cubic meters. Then water shortages will become an issue for the years 1995 and 2000, when it reaches, respectively, about 61.18 million cubic meters and 260.34 million cubic meters (see Figure 8.1 and Figure 8.2). Therefore, such a potential risk should be anticipated by the policy makers and a contingency plans put into action right from 1995 onwards. Some of the measures that the plans need to incorporate or address are as follows.

By looking at the amount of water embodied in the production of goods and services in the economy, one can argue that it can be used to minimize the shortages in water resources. Then using the structure of exports and imports of the economy, we can minimize the problem of water scarcity in the economy.

Therefore, one way of minimizing the total water requirements can be explained by considering the following example. As Table 8.2 shows, for JD 1000 worth of agricultural output to satisfy the final demand, about 1407.09 cubic meters of water are required direct and indirect in the JD 1000 of agricultural output. Therefore, if we assume that a JD 10000

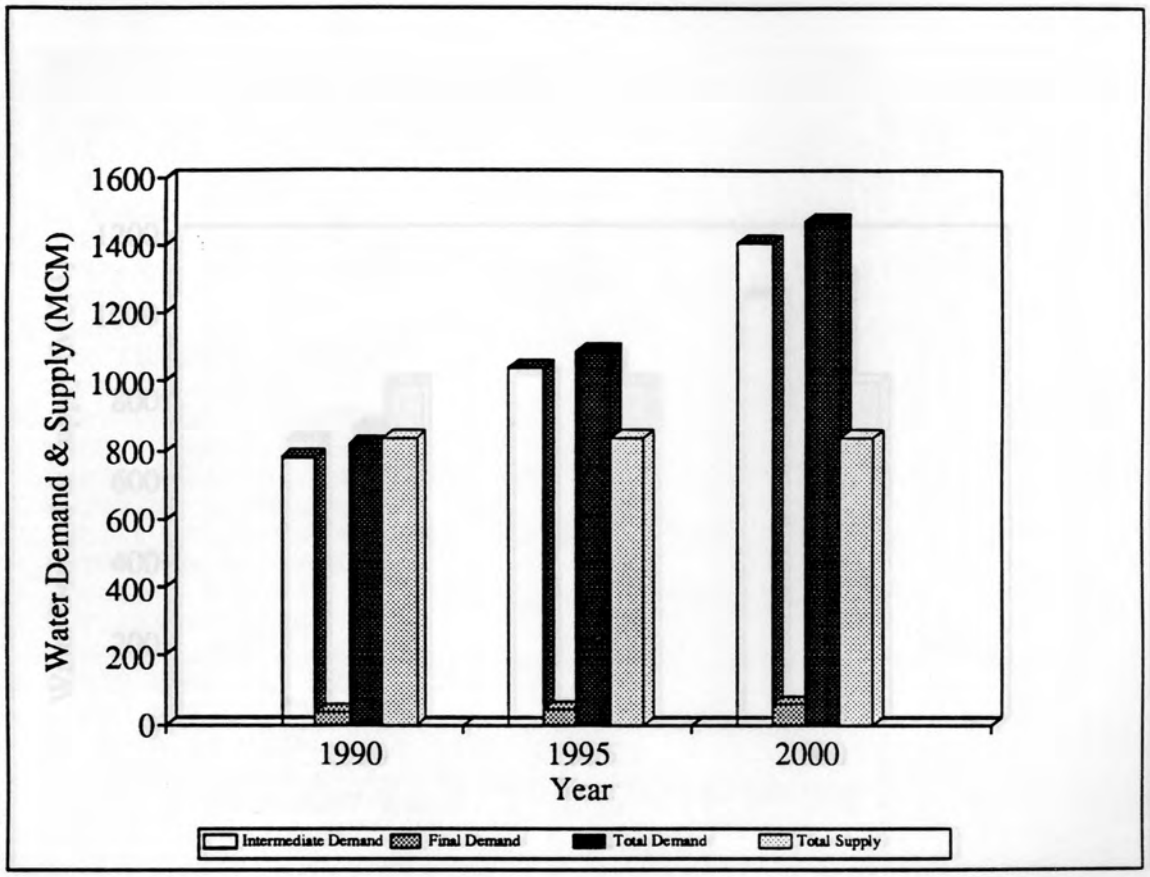

Figure 8.1: Total Water Demand and Supply in Jordan Estimated for 1990-2000, First Growth Scenario.

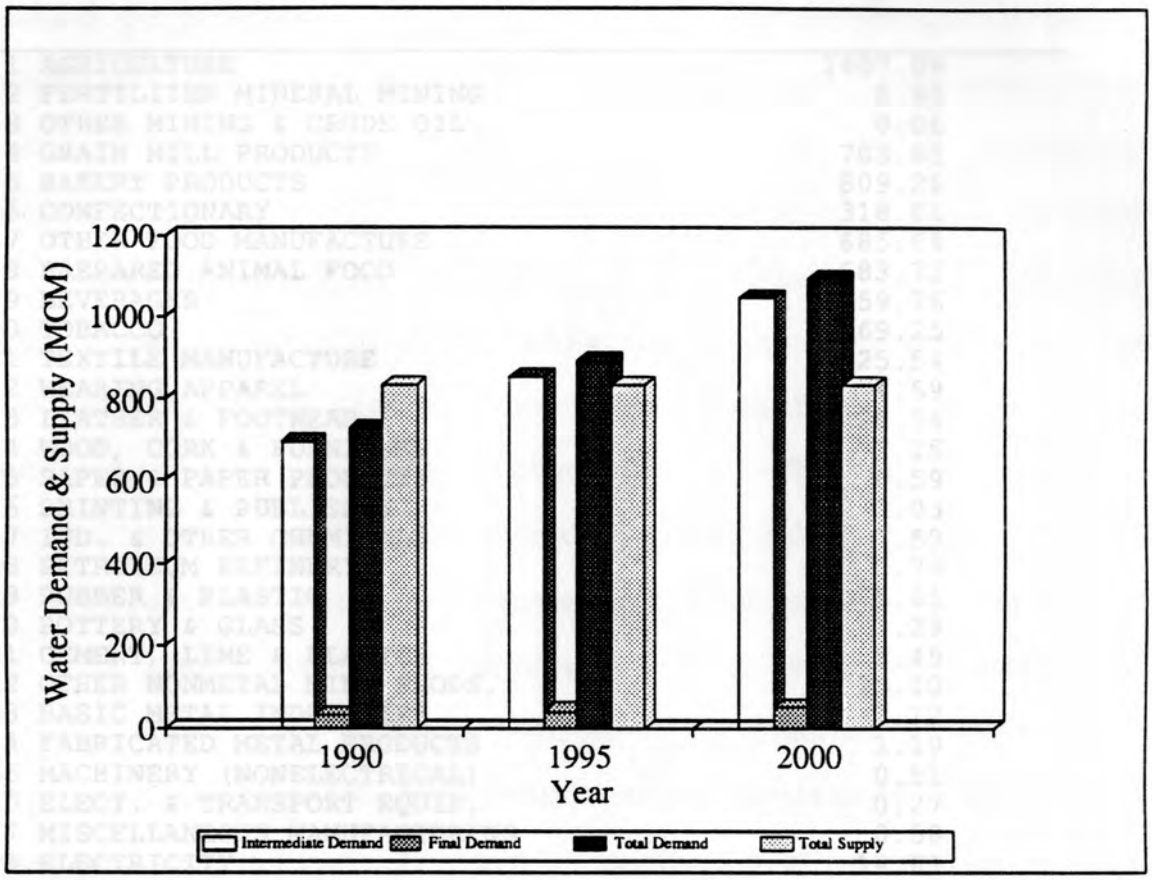

Figure 8.2: Total Water Demand and Supply in Jordan Estimated for 1990-2000, Second Growth Scenario.

Table 8.2: Direct Plus Indirect Water Requirements Per JD 1000 of Final Demand, by Sector, Jordan, 1983 [a]

		Direct plus Indirect Water Requirements (cubic meter)
		1
1	AGRICULTURE	1407.09
2	FERTILIZER MINERAL MINING	8.95
3	OTHER MINING & CRUDE OIL	0.06
4	GRAIN MILL PRODUCTS	703.65
5	BAKERY PRODUCTS	809.26
6	CONFECTIONARY	318.81
7	OTHER FOOD MANUFACTURE	685.69
8	PREPARED ANIMAL FOOD	683.72
9	BEVERAGES	159.76
10	TOBACCO	269.25
11	TEXTILE MANUFACTURE	25.54
12	WEARING APPAREL	4.59
13	LEATHER & FOOTWEAR	28.54
14	WOOD, CORK & FURNITURE	2.15
15	PAPER & PAPER PRODUCTS	6.59
16	PRINTING & PUBLISHING	3.03
17	IND. & OTHER CHEMICALS	7.59
18	PETROLEUM REFINERY	0.76
19	RUBBER & PLASTIC	5.95
20	POTTERY & GLASS	1.29
21	CEMENT, LIME & PLASTER	5.45
22	OTHER NONMETAL MIN. PRODS.	25.10
23	BASIC METAL INDUSTRIES	2.12
24	FABRICATED METAL PRODUCTS	1.19
25	MACHINERY (NONELECTRICAL)	0.51
26	ELECT. & TRANSPORT EQUIP.	0.27
27	MISCELLANEOUS MANUFACTURING	0.58
28	ELECTRICITY	14.01
29	WATER SUPPLY	1000.13
30	CONSTRUCTION	7.54
31	DISTRIBUTION	3.34
32	TRANSPORT & COMMUNICATION	17.15
33	FINANCE & BUSINESS SERVS.	9.62
34	HEALTH & EDUCATION	37.75
35	OTHER SERVICES	41.11

Note: [a] Except for water supply sector where it is expressed as direct plus indirect water requirements per 1000 cubic meter.

worth of agricultural products is needed to meet the total domestic final demand for agricultural products, then about 14070.9 cubic meters of water will be needed throughout the economy. Now, if the JD 10000 worth of agricultural products is produced domestically, then the total amount of water needed to produce them is equal to the total amount of water embodied in their production. If we assume, however, that instead of producing domestically the JD 10000 worth of agricultural products, the economy is going to import half of that production, i.e., JD 5000 worth of agricultural output, from other countries, then this decision will produce some savings in water consumption by cutting back on the total water embodied in the production of JD 10000 worth of agricultural products domestically. That is, the JD 5000 worth of agricultural products produced domestically will require 7035.45 cubic meter of domestic water while enjoying the savings of 7035.45 cubic meters of water that would have been used if the other JD 5000 worth of agricultural output were produced domestically, i.e., using the domestic water resources.

However, the JD 5000 worth of imported agricultural output has to be paid for. So let us assume that the imported agricultural products will be paid by exporting JD 5000 worth of wearing apparel exports. Then for JD 5000 worth of wearing apparel exports produced domestically, there will be about 22.95 cubic meters of water embodied in the production of

wearing apparel exports. So, in this case it is going to be that Jordan will be giving up only 22.95 cubic meters of its water for 7035.45 cubic meters of other country's water. In other words, to supply the final demand with JD 10000 worth of agricultural products, Jordan will consume about 7058.40 cubic meters of its water instead of consuming a total of 14070.9 cubic meters had the JD 10000 worth of agricultural products, to be delivered to the final demand, been produced domestically.[50]

Using the demand side approach to the problem, we could suggest that different conservation measures have to be implemented on three different levels: domestic, industrial, and agricultural.

8.1 The Domestic Level

On the domestic level, for example, these measures could be implemented through conservation by the household sector, encouragement to install water saving equipment or apparatus such as washing machines, toilet, and showers which dispense smaller quantities of water than the older versions. The encouragement to install water saving devices could be carried out through subsides or tax rebates on using such equipment. It could also be done through mandatory use of such water saving equipment in the buildings yet to be constructed. For

[50] For more information on the procedure used in the example above, see (Kelso et al. 1973, 175-186).

those who already using old equipments, encouragement could come through deferring part of the cost for reinstalling the new machines.[51]

8.2 The Industrial Level

On the industrial level, water saving can be enhanced by using recycled water in the cooling system of the industries and discouraging the use of technology that is already obsolete in developed countries but still used by some industries in Jordan. Similarly, water saving can be furthered by supporting research and development programs that lead to ways of cutting down the level of water consumption in industries while increasing their production. In other words, to improve the efficiency of water use throughout the industrial sector definite policies need to be implemented.

8.3 The Agricultural Level

For agriculture, the largest user of water, savings can be augmented through revising agricultural policy and providing farmers with information on what variety of crops should be planted or introduced in their farming practices; that is, to orient the farmers towards crops that use minimum water per unit of output but provide a high revenue. Also a data bank should be created that includes other countries'

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[51] Implementing such policies is clear in some of the water shortages states in the western part of the United States, such as Arizona, California, and Utah.

experience in utilizing water resources in farming, particularly in arid regions and how they cope with the problem of water scarcity, and which technologies they use to minimize the loss of water in irrigation. Irrigation equipment, such as the drip system,[52] that has minimum loss of water should be introduced, and the flood system of irrigation especially in the arid areas where high evaporation and evapotranspiration occur as a result of high temperature should be avoided. Further, this information should be made accessible and conveyed to users through training and demonstration sessions. In addition, recycled water partially in agriculture, such as irrigating forages and animal food-stuff, should be used.[53] Recycled water that does not fit the safe potable criteria for humans could be used for animals or for outdoor uses such as lawn and garden irrigation.

Viewed from the supply side for a solution to the problem, one could recommend such programs as utilizing all the storm water during the winter time by improving the existing dams through increasing their capacities, or building new dams in areas where it is feasible, then using some of these waters, particularly of those built in the desert area,

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[52] The drip system has been introduced in Jordan and is being used by farmers in the Jordan Valley. Also, Israel is considered to be a leading country in developing and using such system in the agriculture. This expertise may be expanded to Jordan sometimes in the future, especially as the peace process proceeds, and develop regional cooperation in the area of utilizing water resources, particularly in agriculture, since both countries face a potential problem in their water resources.

[53] Jordan has introduced the use of recycled water in agriculture on a limited scale.

to replenish underground aquifers. Otherwise, most of water collected during winter storms will be lost to the evaporation due to the high temperature during summer times. Also the water delivery networks should be inspected, the parts that are aging replaced,[54] and the water meter system fixed in order to curtail the quantity of water not being paid for and to get a better idea of the quantity of water that is being used in the economy.

Recycled water could be used in replenishing the underground aquifers to increase the water tables, as another way of increasing the available water supply.

Increasing water supply may be achieved by sharing technologies in harnessing water resources, and the possibility of using cloud seeding techniques on a regional level. In addition, the supply of water may be augmented by studying the feasibility of desalination, and the use of solar energy as a source of minimizing the cost of such technology. Another possibility of increasing water supply is through importing water from neighboring countries who have excess or well-endowed in their supplies, and who are willing to

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[54] In Jordan, according to the files of the Ministry of Water and Irrigation, water losses from aging connections and networks was estimated at about 25 percent in 1985. However, the water losses problem is not only the case in Jordan, it can also be seen in other developing nations. For example, Munasinghe (1992) agues that in Egypt, due to its aging networks, water losses in some areas reach more than 60 percent of its gross production. He also added that in other areas such as Buenos Aires, Managua, and Mexico City, the water losses reach around 50 percent. While normally, the average water losses should be below 20 percent of gross production, and the level of economically optimal loss should be as low as 10 percent.

exchange such precious resource.

It is vital for Jordan to reach an agreement with the other riparian states on the dispute over water rights in the Jordan River basin. Solving this issue will augment Jordan's water supply with additional quantity of about 367 to 377 million cubic meters annually.[55]

It is also important for Jordan to update the availability of its water resources, and to see if there are other sources that may be tapped in the future.

One way of approaching a solution to the problem of water shortages is to seek what is called an insurance paid by the existing generations for the future generations; that is, water consumption should be reduced now and stored for future use under conditions of drought or other unforeseen situations such as that which occurred during the 1990/1991 Gulf War when waves of refugees from different nationalities fled into Jordan and exerted unforeseen pressures on the economy including water resources. If we assume, for instance, that the probability of the drought cycle, based on previous information, is every four years, then this situation could be approached through conservation in the use of water throughout the economy. This can be achieved also by decreasing the level of pumping of underground water, or withdraw less water from

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[55] Jordan currently use about 100 to 110 million cubic meters from Yarmouk River and nothing from the Jordan River. However, according to the Johnston Plan, the Jordan allotment of water from the Yarmouk River were 377 million cubic meters and from the Jordan River were 100 million cubic meters (Cowell 1993).

the reservoirs in order to accumulate for conditions when it becomes scarce. In other words, we need to apply water rationing policy ahead of time so that when the drought cycle approaches we will be prepared.

APPENDIX

CONVERSION FACTORS

	To convert	Multiply by	To obtain
Area:			
	square meters	1550.0	square inch
		10.76	square feet
		1.196	square yards
		3.86×10^{-7}	square miles
		2.47×10^{-4}	acre
		1.0×10^{-4}	hectare (ha)
	hectare (ha)	1.0×10^{4}	square meters
		1.076×10^{5}	square feet
		1.196×10^{4}	square yards
		3.861×10^{-3}	square miles
		2.47	acre
		10.0	dunums
	dunum (du.)	1.0×10^{3}	square meters
		0.10	hectare (ha)
		0.0247	acre
Length:			
	millimeter (mm)	0.0394	inch
	centimeter (cm)	0.3937	inch
	meter (m)	39.37	inch
		3.28	feet
		1.094	yard (yd)
		6.21×10^{-4}	mile
	kilometer (km)	3281.0	feet
		0.621	mile
		1.0×10^{3}	meter
Volume:			
	cubic meter (CM)	6.1023×10^{4}	cubic inch
		35.288	cubic feet
		264.17	gallons
		8.1×10^{-4}	acre-feet
		1.0×10^{3}	liters
	acre-feet (ac-ft.)	1234.57	cubic meters
		3.26×10^{5}	gallons
		1.23457×10^{6}	liters
		75.27×10^{6}	cubic inch

SELECTED BIBLIOGRAPHY

Abbas A. T., B. M. 1982. The Ganges waters dispute. New Delhi: Vikas Publishing House PVT Ltd.

Abu Rizaiza, Omar S. 1991. Residential water usage: A case study of the major cities of the western region of Saudi Arabia. Water Resources Research 27, no. 5 (May): 667-671.

Altaf, Mir Anjum, Dale Whittington, Haroon Jamal, and V. Kerry Smith. 1993. Rethinking rural water supply policy in the Punjab, Pakistan. Water Resources Research 29, no. 7 (July): 1943-1954.

American Friends of the Middle East, Inc. 1964. The Jordan water problem: An analysis and summary of available documents. Washington, D.C.: American Friends of the Middle East, Inc.

Anderson, Ewan W. 1987. Water resources and boundaries in the Middle East. In Boundaries and State Territory in the Middle East and North Africa, ed. Gerald H. Blake and Richard N. Schofield, 85-98. Gallipoli House, The Cottons, Outwell, Wisbech, Cambridgeshire, England: Middle East and North African Studies Press, Ltd.

———. 1988. Water: The next strategic resource. In The Politics of Scarcity: Water in the Middle East, ed. Joyce R. Starr and Daniel C. Stoll, 1-21. Boulder, London: Westview Press.

Anderson, Thomas C. 1972. Water resources planning to satisfy growing demands in an urbanizing agricultural region. Logan: Utah State University, Utah water research laboratory, College of Engineering. (April).

Balbesi, Mu'taz, and Mohammed Beni-Hani. 1990. Water resources and its uses in Jordan. In The Arab Countries' Water Resources and its Strategic Importance: Proceedings of Conference on Arab countries' water resources held in Amman 2-4 April 1989, (in Arabic), edited by Mohammed Adnan al-Bakheit and Elias Salameh 35-101. Amman, Jordan: The University of Jordan Press.

Bargur, Jona. 1972. Dynamic multisector programming approach to regional water resource management. Water Resources

Research 8, no. 4 (August): 801-817.

Bargur, Jona, and P. H. McGauhey. 1969. Economic evaluation of water, Part VI: A dynamic interregional input-output programming model of the California and western states water economy. Berkeley: University of California, Berkeley, Sanitary Engineering Research Laboratory, Water Resources Center, Contribution no. 128. (June).

Baum, Christopher F., John M. Munro, and Gustav Schachter. 1990. Structural change and economic development in southern Italy. The Journal of Development Studies 27, no. 1 (October): 54-71.

Baumann, Duane D., and Yacov Y. Haimes, eds. 1988. The role of social and behavioral sciences in water resources planning and management. New York: American Society of Civil Engineers.

Beaumont, Peter. 1989. Environmental management and development in drylands. London and New York: Routledge.

Beaumont, Peter, and Keith McLachlam, eds. 1985. Agricultural development in the Middle East. Chichester, New York, Singapore: John Wiley and Sons.

Berk, Richard A., C. J. LaCivita, Katherine Sredl, and Thomas F. Cooley, eds. 1981. Water shortage: Lessons in conservation from the Great California Drought, 1976-1977. Cambridge, Mass.: Abt Books.

Biswas, Asit K. 1981. Water for the third world. Foreign Affairs 60 (Fall): 148-166.

Blair, Peter D. 1979. Multiobjective regional energy planning: Application to the energy park concept. Boston, The Hague, London: Martinus Nijhoff Publishing.

Blattenberger, Gail R., and George R. Moore. 1976. An integer programming analysis of alternative Churchill River diversions. Winnipeg, Manitoba: University of Manitoba, The Agassiz Center, Research no. 10.

Blitzer, Charles R., Peter B. Clark, and Lance Taylor, eds. 1975. Economy-wide models and development planning. London, New York: Oxford University Press.

Bohm, Robert A., Timothy J. Essenburg, and William F. Fox. 1993. Sustainability of potable water services in the Philippines. Water Resources Research 29, no. 7 (July): 1955-1963.

Bradley, Iver E. 1967. Utah interindustry study: An input-output analysis. Utah Economic and Business Review 27, no. 7 (July-August): 1-13.

Bradley, Iver E., and J. P. Gander. 1968. The economics of water allocation in Utah: An input-output analysis, Salt Lake City: University of Utah, Bureau of Economics and Business Research.

Brajer, Victor, and Wade E. Martin. 1989. Allocating a 'scarce' resource, water in the west: More market-like incentives can extend supply, but constraints demand equitable policies. American Journal of Economics and Sociology 48, no. 3 (July): 259-271.

Brams, Marvin. 1971. Pricing policies of the water industry: a case study of northern New Castle county, Delaware. Economic and Business Bulletin 23, no. 3: 37-42.

Brookshire, David S., and Dale Whittington. 1993. Water resources issues in the developing countries. Water Resources Research 29, no. 7 (July): 1883-1888.

Bulmer-Thomas, V. 1982. Input-output analysis in developing countries: Sources, methods and applications. Chichester, New York, Brisbane, Toronto, Singapore: John Wiley & Sons Ltd.

Caponera, Dante A. 1954. Water laws in Moslem countries. FAO Development paper no. 43, Rome, Italy, (March).

Carter, Anne P. 1970. Structural change in the American economy. Cambridge, Mass.: Harvard University Press.

Carter, Anne P., and A. Brody, eds. 1972. Input-output techniques: Proceedings of the fifth International Conference on Input-Output Techniques held in Geneva January 1971. Amsterdam, London: North-Holland Publishing Company, and American Elsevier Publishing Co., Inc.-New York.

Carter, H. O., and D. Ireri. 1970. Linkage of California-Arizona input-output models to analyze water transfer patterns. In Applications of Input-Output Analysis: Proceedings of the fourth International Conference on Input-Output Techniques held in Geneva 8-12 January 1968, edited by A. P. Carter and A. Brody, Vol. 2, 139-167. Amsterdam, London: North-Holland Publishing Company.

Caswell, Margriet, Erik Lichtenberg, and David Zilberman. 1990. The effects of pricing policies on water conservation and drainage. American Journal of

Agricultural Economics 72, no. 4 (November): 883-890.

Caswell, Margriet F., and David Zilberman. 1990. Managing California's water in the long run. Contemporary Policy Issues 8, no.4 (October): 92-105.

Central Bank of Jordan (CBJ). 1988. Twenty fifth annual report. [Amman, Jordan]: Central Bank of Jordan (CBJ).

———. 1989. Department of research and studies. Yearly statistical series (1964-1989): Special issue. [Amman, Jordan]: Central Bank of Jordan (CBJ). Department of Research and Studies. (October).

———. 1990. Twenty seventh annual report. [Amman, Jordan]: Central Bank of Jordan (CBJ).

———. 1991. Monthly statistical bulletin. [Amman, Jordan]: Central Bank of Jordan (CBJ).

Charnock, Anne. 1984. Water resources: Strategic concerns speed search for new answers. Middle East Economic Digest (MEED), 10 August, 27-37.

Clark, Robert M., and Haynes C. Goddard. 1974. Pricing for water supply: Its impact on systems management. Cincinnati: National Environmental Research Center, U. S. Environmental Protection Agency, (April).

Clyde, Calvin G., Alton B. King, and Jay C. Andersen. 1971. Application of operations research techniques for allocation of water resources in Utah. Logan: Utah State University, Utah water research laboratory, college of engineering. (September).

Cochran, Richard, and Arthur W. Cotton. 1985. Municipal water demand study, Oklahoma City and Tulsa, Oklahoma. Water Resources Research 21, no. 7 (July): 941-943.

Cocklin, C., M. Harte, and S. Lonergan. 1989. Patterns of change in the use of energy in the New Zealand economy. Environment and Planning A 21, no. 9 (September): 1141-1156.

Coone, Tim, Sara O'Niel, and Ian Meadows. 1981. Water politics. The Middle East (February): 47-54.

Cowell, Alan. 1993. Hurdle to peace: Parting the Mideast's waters. New York Times, 10 October.

Darr, P., S. L. Feldman, and Ch. Kamen. 1976. The Demand for urban water. Leiden: Martinus Nijhoff Social Sciences

Division.

Davis, H. Craig. 1969. Interregional production and water resource dependencies among the western states. Western Economic Journal 7, no. 1 (March): 27-40.

Dean, Robert B., and Ebba Lund. 1981. Water reuse: Problems and solutions. London, New York, Toronto, Sydney, San Francisco: Academic Press.

Demetriades, E. I., and D. A. Petrondas, eds. 1989. Input-output applications for Cyprus: Proceedings of the symposium on Input-Output Tables, 1988. Research Papers and Reports: Series 2, Report no. 13. Cyprus: Department of Statistics and Research, Ministry of Finance.

Department of Statistics (DOS), Jordan. 1989. Statistical yearbook 1989, no. 40. Amman, Jordan: Government Printing Office.

Department of Water Resources. 1980. Measuring the economic impacts: The application of input-output analysis to California water resources problems. State of California: The Resources Agency, Bulletin 210, (March).

Dorfman, Robert. 1954. The nature and significance of input-output. The Review of Economics and Statistics 36, no. 2 (May): 121-133.

Dorfman, Robert, Paul A. Samuelson, and Robert M. Solow. 1958. Linear programming and economic analysis. New York, Toronto, and London: McGraw-Hill Book Company, Inc.

Eleish, Gamal E. 1967. The input-output model in a developing economy: Egypt. In Structural interdependence and economic development: Proceedings of an International Conference on Input-Output Techniques held in Geneva September 1961, edited by Tibor Barna, Willian I. Abraham, and Zoltan Kenessey 199-223. London, Melbourne, Toronto, Macmillan and New York: St. Martin's Press.

Elkilani, Mohamed Abdulkarim. 1988. An evaluation of agricultural water problems in Libya as affected by government policies. Ph.D. diss., The University of Texas At Dallas, Dallas, Texas.

Engelbert, Ernest A., and Ann Foley Scheuring, eds. 1982. Competition for California water: Alternative resolutions. Berkeley, Los Angeles & London: University of California Press.

Erdosi, Pal. 1985. The role of energy intensity in economic

development. In Lecture notes in economics and mathematical systems, ed. A. Smyshlyaev, 221-224. Berlin, New York, Tokyo: Springer-Verlag.

Fass, S. M. 1993. Water and poverty: Implications for water planning. Water Resources Research 29, no. 7 (July): 1975-1981.

Food and Agriculture Organization of the United Nations (FAO). 1982. Regional study on rainfed agriculture and agro-climatic inventory of eleven countries in the Near East region. Rome: Food and Agriculture Organization of the United Nations (FAO).

Frederick, Kenneth D., and Diana C. Gibbons, eds. 1986. Scarce water and institutional change. Washington, D.C.: Resources for the Future, Inc.

Garber, Andra, and Elias Salameh. 1992. Jordan's water resources and their future potential: Proceedings of the symposium 27-28 October 1991. Amman, Jordan: Friedrich Ebert Stiftung.

Gischler, Christiaan E. 1979. Water resources in the Arab Middle East and North Africa. Gallipoli House, The Cottons, Outwell, Wisbech, Cambridge, England: Middle East and North African Studies Press Ltd.

Gould, Brian W. 1986. The impacts of structural change within an economy on resource use: An input-output analysis. Applied Economics 18, no. 5 (May): 457-477.

Gowdy, John M., and Jack L. Miller. 1987. Energy use in the U.S. service sector: An input-output analysis. Energy 12, no. 7 (July): 555-562.

Gray, S. L., and J. R. McKean. 1976. The development of water multiplier impacts from input-output analysis: An empirical example from Boulder, Larimer, and Weld Counties, Colorado. Water Resources Research 12, no. 2 (April): 135-140.

Haddadin, Munther. 1990. Water resources and its uses in Jordan. In The Arab countries' water resources and its strategic importance: Proceedings of conference on water resources in Arab countries held in Amman 2-4 April 1989, edited by Mohammed Adnan al-Bakheit and Elias Salameh 19-30, (in Arabic). Amman, Jordan: The University of Jordan Press.

Haddadin, Munther. 1992. Water and the peace process: Two perspectives--A view from Jordan. Policy Focus. The

Washington Institute for Near East Policy, Research Memorandum, no. 20, (September): 1-20.

Hannon, Bruce, and Thomas Blazeck. 1984. The marginal energy cost of goods and services. Energy Systems and Policy 8, no. 2: 85-112.

Hartman, L. M. 1965. The input-output model and regional water management. Journal of Farm Economics 47, no. 5 (December): 1583-91.

Hendricks, David W., and Roger W. De Haan. 1975. Input-output modeling in water resources system planning. Fort Collins: Colorado State University, Department of Civil Engineering, no. 3 (November).

Hirsch, Werner Z. 1959. Interindustry relations of a metropolitan area. The Review of Economics and Statistics 41, no. 4 (November): 360-69.

———. 1967. Application of input-output techniques to urban areas. In Structural interdependence and economic development: Proceedings of an International Conference on Input-Output Techniques held in Geneva, September 1961, edited by Tibor Barna Willian I. Abraham, and Zoltan Kenessey, 151-168. London, Melbourne, Toronto, Macmillan, and New York: St. Martin's Press.

Howe, Charles W. 1979. Natural resource economics: Issues, analysis, and policy. New York, Chicester, Brisbane, Toronto: John Wiley and Sons, Inc.

———., ed. 1982. Managing renewable natural resources in developing countries. Boulder, Colo.: Westview Press, Inc.

Howe, Charles W., and John A. Dixon. 1993. Inefficiencies in water project design and operation in the Third World: An economic perspective. Water Resources Research 29, no. 7 (July): 1889-94.

Ireri, D., and H. O. Carter. 1970. California-Arizona economic interdependence and water transfer patterns. Davis: University of California, California Agricultural Experiment Station, Giannini Foundation of Agricultural Economics, Giannini Foundation Research Report no. 313, (October).

Isard, Walter. 1960. Methods of regional analysis: An introduction to regional science. Cambridge, Mass., and London, England: The M.I.T. Press.

Issawi, Charles. 1985. The Middle East in the world economy: A long range historical view. Washington, D.C.: Center for Contemporary Arab Studies, Georgetown University.

Jermar, Milan K. 1987. Water resources and water management. Amsterdam, Oxford, New York, Tokyo: Elsevier Science Publishing Company, Inc.

Kally, Elisha, and Gideon Fishelson. 1993. Water and peace: Water resources and the Arab-Israeli peace process. Westport, Conn., London: Praeger.

Kanazawa, Mark T. 1994. Water subsidies, water transfers, and economic efficiency. Contemporary Economic Policy (Formerly Contemporary Policy Issues) 12, no. 2 (April): 112-22.

Kelso, Maurice M., William E. Martin, and Lawrence E. Mack. 1973. Water supplies and economic growth in an arid environment: An Arizona case study. Tucson, Ariz.: The University of Arizona Press.

Kerr, Charles, ed. 1989. Community water development. London: Intermediate Technology Publications, Ltd.

Khouri, Rami G. 1981. The Jordan Valley: Life and society below sea level. London and New York: Longman.

Kindler, J., and C. S. Russell, et al. eds. 1984. Modeling water demands. London, New York, Tokyo: Academic Press Inc. (London) Ltd.

Kolars, John. 1990. The course of water in the Arab Middle East. American Arab Affairs, no. 33 (Summer): 57-68.

Ku'war, Sameer. 1992. An Interview Published in AD-Dustour Newspaper (Jordan), no. 9088, 9 December.

———— . 1993. An interview published in AD-Dustour Newspaper (Jordan) 26, no. 9174.

Lee, Terence R. 1969. Residential water demand and economic development. University of Toronto Department of Geography: University of Toronto Press.

Lee, Terence Richard. 1990. Managing water resources in Latin America. Natural Resources Journal 30 (Summer): 581-607.

Leontief, Wassily W. 1936. Quantitative input and output relations in the economic system of the United States. The Review of Economics and Statistics 18, no. 3 (August): 105-125.

———. 1986. Input-output economics. 2d ed. New York, Oxford: Oxford University.

Lofting, E. M., and P. H. McGauhey. 1963. Economic evaluation of water, Part III: An interindustry analysis of the California water economy. Berkeley: University of California, Berkeley, Sanitary Engineering Research Laboratory, Water Resources Center, Contribution no. 67 (January).

Logan, Bernard I. 1986. An applied analysis of rural water supply planning in Sierra Leone. Socio-Economic Planning Sciences 20, no. 5: 275-282.

Lowi, Miriam. 1984. The politics of water: The Jordan River and the Riparian states. Montreal: McGill Studies in International Development, no. 35.

———. 1993. Water and power: The politics of scarce resource in the Jordan River basin. Cambridge: Cambridge University Press.

Lycett, Andrew. 1981. Special survey: Water resources. The Middle East, (October): 79-84.

Martin, William E., and Susan Kulakowski. 1991. Water price as a policy variable in managing urban water use: Tucson, Arizona. Water Resources Research 27, no. 2 (February): 157-66.

Mazur, Michael P. 1979. Economic growth and development in Jordan. Boulder, Colo.: Westview Press.

McDonald, Adrian, and David Kay. 1988. Water resources: Issues and strategies. New York: John Wiley and Sons, Inc.

Midmore, Peter, ed. 1991. Input-output models in the agricultural sector. Aldershot, Brookfield, USA; Hong Kong, Singapore, Sydney: Avebury.

Miernyk, William H. 1965. The elements of input-output analysis. New York: Random House.

Miernyk, William H., Frank Giarratani, and Charles F. Socher. 1978. Regional impacts of rising energy prices. Cambridge, Mass.: Ballinger Publishing Company.

Miller, G. Tylor, Jr. 1990. Resource conservation and management. Belmont, Calif.: Wadsworth Publishing Co.

Miller, Ronald E. 1957. The impact of the aluminum industry on the Pacific Northwest: A regional input-output analysis.

The Review of Economics and Statistics 39, no. 2 (May): 200-09.

Miller, Ronald E., Karen R. Polenske, and Adam Z. Rose, eds. 1989. Frontiers of input-output analysis. New York, Oxford: Oxford University Press.

Miller, Ronald E., and Peter D. Blair. 1985. Input-output analysis: Foundations and extensions. Englewood Cliffs, New Jersey: Prentice-Hall, Inc.

Milliken, J. Gordon, and Graham C. Taylor. 1981. Metropolitan water management. Washington, D.C.: American Geophysical Union.

Ministry of Labor and Social Development, Jordan. Research Department. 1985. Yearly report, Table 1, p. 16. [Amman, Jordan]: Ministry of Labor and Social Development, Jordan. Research Department.

Ministry of Labor, Jordan. Research department. 1988. Yearly report, Table 1-1, p. 21. [Amman, Jordan]: Ministry of Labor, Jordan. Research Department.

————. 1989. Yearly report, Table 1-1, p. 19. [Amman, Jordan]: Ministry of Labor, Jordan. Research Department.

Ministry of Planning (MOP), Jordan. 1986. Five year plan for social and economic development 1986-1990. [Amman, Jordan]: Ministry of Planning (MOP), Jordan.

Ministry of Water and Irrigation, Water Authority, Jordan. 1990. Yearly report, Table no. 10, p. 25. [Amman: Jordan]: Ministry of Water and Irrigation, Water Authority, Jordan.

al-Momani, Ayman Hassan. 1988. Modeling of future water demand and supply in Jordan--A tool for planning. Ph.D. diss., Oklahoma State University.

Moncur, James E. T. 1974. A preliminary input-output water planning model for Hawaii. Office of Water Research and Technology, Technical Memorandum Report no. 40, (June).

Moore, Frederick T., and James W. Petersen. 1955. Regional analysis: An interindustry model of Utah. The Review of Economics and Statistics 37, no. 4 (November): 368-383.

Morris, John R. 1990. Pricing for water conservation. Contemporary Policy Issues 8, no. 4 (October): 79-91.

————. 1991. Water conservation progress in Denver.

Contemporary Policy Issues 9, (July): 35-45.

Mujeri, Mustafa K., and Mohammad Alauddin. 1992. The use of input-output analysis in determining import intensity of consumption: Evidence from Bangladesh. Queensland, Australia: University of Queensland, Department of Economics, Discussion Paper no. 77, (January).

Munasinghe, Mohan. 1992. Water supply and environmental management: Developing world applications. Boulder, San Francisco, Oxford: Westview Press.

Nabeel, Mustafa. 1979. The Litani: Arabic river in danger. AlArabi, no. 245 (April): 72-91.

Naff, Thomas, and Ruth C. Matson, eds. 1984. Water in the Middle East: Conflict or cooperation?. Boulder and London: Westview Press.

Natur, Fahd Salih. 1985. Water supply for the agricultural sector. In Agricultural sector of Jordan: Policy and systems studies, ed. A. B. Zahlan, 197-273. London: Ithaca Press.

Natural Resources Authority (NRA), Jordan. 1988. Natural resources in Jordan. [Amman, Jordan]: Natural Resources Authority (NRA), Jordan. (December).

O'Connor, Robert, and Edmund W. Henry. 1975. Input-output analysis and its applications. Monograph no. 36. London and High Wycombe: Charles Griffin and Company Ltd.

Organization for Economic Co-operation and Development (OECD). 1989. Water resource management: Integrated policies. Paris: Organization for Economic Co-operation and Development (OECD).

Oshikoya, Temitope Waheed. 1990. The Nigerian economy: A macroeconometric and input-output model. New York, London: Praeger.

Otto, Daniel M., and Thomas G. Johnson, eds. 1993. Microcomputer-based input-output modeling: Applications to economic development. Boulder, San Francisco, Oxford: Westview Press.

Phillips, Almarin. 1955. The tableau economique as a simple Leontief model. The Quarterly Journal of Economics 69, no. 1 (February): 137-44.

Phillips, Paul Grounds. 1954. The Hashemite Kingdom of Jordan: Prolegomena to a technical assistance program (Research

Paper no. 34). Chicago: Chicago University, Department of Geography, Research Paper nos. 34-36, (March).

Postel, Sandra.1993. The politics of water. World Watch 6, no. 4, (July-August): 10-18.

Proops, J. L. R. 1977. Input-output analysis and energy intensities: A comparison of some methodologies. Applied Mathematical Modelling 1, no. 4 (March): 181-86.

———. 1988. Energy intensities, Input-output analysis and economic development. In Input-Output Analysis: Current Developments, ed. Maurizio Ciaschini, chapter 13: 201-215. London, New York: Chapman and Hall.

Qasem, Subhi, and Mark Mitchell. 1986. The problems of rain-fed agriculture. In Agricultural policy in Jordan, ed. Alison Burrel, 30-40. London and Atlantic Highlands: Ithaca Press.

Raphael, C. Nicholas, and Hussain T. Shaibi. 1984. Water resources for AT Taif, Saudi Arabia: A study of alternative sources for an expanding urban area. The Geographical Journal 150, no. 2 (July): 183-91.

Reid, George W., ed. 1982. Appropriate methods of treating water and wastewater in developing countries. Ann Arbor, Michigan: Ann Arbor Science Publishers, The Butterworth Group.

Rogers, Peter, Christopher Hurst, and Nagaraja Harshadeep. 1993. Water resources planning in a strategic context: Linking the water sector to the national economy. Water Resources Research 29, no. 7 (July):1895-1906.

Rubin, Rehav. 1988. Water conservation methods in Israel's Negav Desert in late antiquity. Journal of Historical Geography 14, no. 3 (July): 229-244.

Saket, Bassam. 1985. The Jordanian economy. In Agricultural sector of Jordan: Policy and systems studies, ed. A. B. Zahlan, 9-39. London: Ithaca Press.

Salameh, Elias. 1992. Jordan depleting its water resources in 120 percent annually. An Interview with AD-Dustour Newspaper 26, no. 9041 (October).

———. 1990. Jordan water resources: Development and future prospects. American Arab Affairs, no. 33 (Summer): 69-77.

Salameh, Elias, and Helen Bannayan. 1993. Water resources of Jordan present status and future potentials. Amman,

Jordan: Friedrich Ebert Stiftung.

Saleh, Hassan A. K. 1991. Water resources and food production in Jordan. In Politics and The Economy in Jordan, ed. Rodney Wilson, 17-59. London and New York: Routledge.

Saliba, Samir N. 1968. The Jordan River Dispute. The Hague, The Netherlands: Martinus Nijhoff.

Schaffer, William A., E. A. Laurent, C. F. Floyd, E. M. Sutter Jr., C. K. Hamby, and R. C. Herbert, eds. 1976. On the use of input-output models for regional planning. Leiden: Martinus Nijhoff Social Sciences Division.

Schmida, Leslie. 1983. Keys to control: Israel's pursuit of Arab water resources. Washington, D.C.: American Educational Trust.

Shwadran, Benjamin. 1959. Jordan a State of tension. New York: Council For Middle Eastern Affairs Press.

Singh, Bhanwar, Radhika Ramasubban, Ramesh Bhatia, John Briscoe, Charles C. Griffen, and Chongchun Kim, eds. 1993. Rural water supply in Kerala, India: How to emerge from a low-level equilibrium trap. Water Resources Research 29, no. 7 (July): 1931-1942.

Skold, Melvin D., Shinnawi Abdel Atty El shinnawi, and M. Lofty Nasr. 1984. Irrigation water distribution along branch canals in Egypt: Economic effects. Economic Development and Cultural Change 32, no. 3 (April): 547-567.

Starr, Joyce R., and Daniel C. Stoll, eds. 1988. The politics of scarcity: Water in the Middle East. Boulder and London: Westview Press.

Talal, al-Hassan ibn. 1989. "Israel: The water and the Arabs," Interview by Madeha Rasheed al-Medfa'ai, 18 August. Interview transcript. Amman, Jordan.

Thrall, Robert M., E. Heady, T. Schad, A. K. Schwartz, and R. G. Thompson, eds. 1976. Economic modeling for water policy evaluation. Amsterdam, Oxford, New York: North-Holland Publishing Company.

Tiebout, Charles M. 1969. An empirical regional input-output projection model: The state of Washington 1980. The Review of Economics and Statistics 51, no. 3 (August): 334-340.

Todaro, Michael P. 1971. Development planning: Models and

Methods. Nairobi, Dar es Salaam, Lusaka, Addis Ababa: Oxford University Press.

United Nations. Department of International Economic and Social Affairs, Statistical Papers, Series M, no. 4, Rev. 3. 1990. International standard industrial classification of All economic activities. New York.

U.S. Department of Agriculture. Economics, Statistics, and Cooperative Service. Agriculture handbook, no. 530. 1978. Regional development and plan evaluation: The use of input-output analysis. [Washington, D.C.]: U.S. Department of Agriculture. Economics, Statistics, and Cooperative Service.

U.S. Department of Commerce. Economics and Statistics Administration, Bureau of Economic Analysis. 1992. Regional multipliers: A user handbook for the regional input-output modeling system (RIMS II). 2d Edition. [Washington, D.C.]: U.S. Department of Commerce. Economics and Statistics Administration, Bureau of Economic Analysis.

Utton, Albert E., and Ludwik Teclaff, eds. 1978. Water in a developing world: The management of a critical resource. Boulder, Colorado: Westview Press.

Vesilind, Priit J. 1993. The Middle East's water critical resource. National Geographic 183, no. 5 (May): 38-70.

Vine, Peter. 1987. Jewels of the Kingdom: The heritage of Jordan. London: IMMEL Publishing.

Water Authority, Jordan. 1985. The water situation in Jordan and the water policy suggested until year 2000, (in Arabic). Water Authority, Jordan. (March).

al-Weshah, Radwan al-Mubarak. 1992. Jordan's water resources: Technical perspectives. Water International 17, no. 3 (September): 124-132.

Williams, Martin. 1985. Estimating urban residential demand for water under alternative price measures. Journal of Urban Economics 18, no. 2 (September): 213-25.

Wishart, David. 1985. The political economy of conflict over water rights in the Jordan Valley from 1890 to present. Ph.D. diss., University of Illinois at Urbana-Champaign.

———. 1989. An economic approach to understanding Jordan Valley water disputes. Middle East Review (Summer): 45-53.

Zahlan, A. B. 1986. Agriculture as a source of growth in the Jordanian economy. In Agricultural policy in Jordan, ed. Alison Burrel, 122-26. London and Atlantic Highlands: Ithaca Press.

Zilberman, David, Neal MacDougall, and Farhed Shah. 1994. Changes in water allocation mechanisms for California agriculture. Contemporary Economic Policy (Formerly Contemporary Policy Issues) 12, no. 1 (January): 122-133.